HAZARD RANKING SYSTEM (HRS) DOCUMENTATION RECORD COVER SHEET

Name of Site: Clinch River Corporation

EPA ID No.: TND987768587

Contact Persons

Documentation Record:

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Pathways, Components, or Threats Not Scored

The ground water migration, soil exposure, and air migration pathways were not scored in this Hazard Ranking System (HRS) documentation record because the surface water migration pathway is sufficient to qualify the site for the National Priorities List (NPL). These pathways are of concern to the U.S. Environmental Protection Agency (EPA), and may be considered during a future evaluation.

HAZARD RANKING SYSTEM (HRS) DOCUMENTATION RECORD

Name of Site:	Clinch River Corporation
EPA Region:	4
Date Prepared:	September 2012
Street Address of Site*:	728 Emory Drive
City, County, State, Zip:	Harriman, Roane County, Tennessee, 37748
General Location in the State:	Eastern portion of state
Topographic Map:	Bacon Gap, TN 1980; Cave Creek, TN 1989; Elverton, TN 1990; Harriman, TN 1980
Latitude:	35° 55' 55.02" North
Longitude:	84° 32' 21.77" West

The coordinates above for Clinch River Corporation (CRC) were measured from soil sample CR09 0709SF, collected west of the former paper and pulp mill building and within Source No. 1 of this HRS documentation record (Refs. 4; 8, p. 30; 16, p. 4).

* The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area where the site is located. They represent one or more locations EPA considers part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, and not on precisely delineated boundaries. A site is defined as an area where a hazardous substance has been "deposited, stored, placed, or otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release represent the initial determination that a certain area may need to be addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed about where the contamination has come to be located.

Pathway	**Pathway Score**
Ground Water Migration	NS
Surface Water Migration	96.06
Soil Exposure	NS
Air Migration	NS
HRS SITE SCORE	**48.03**

Note:

NS Not scored

WORKSHEET FOR COMPUTING HRS SITE SCORE

	S Pathway	S^2 Pathway
Ground Water Migration Pathway Score (S_{gw})	NS	NS
Surface Water Migration Pathway Score (S_{sw})	96.06	9,227.5236
Soil Exposure Pathway Score (S_s)	NS	NS
Air Migration Pathway Score (S_a)	NS	NS
$S^2_{gw} + S^2_{sw} + S^2_s + S^2_a$		9,227.5236
$(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a) / 4$		2,306.8809
$\sqrt{(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a) / 4}$		**48.03**

Note:

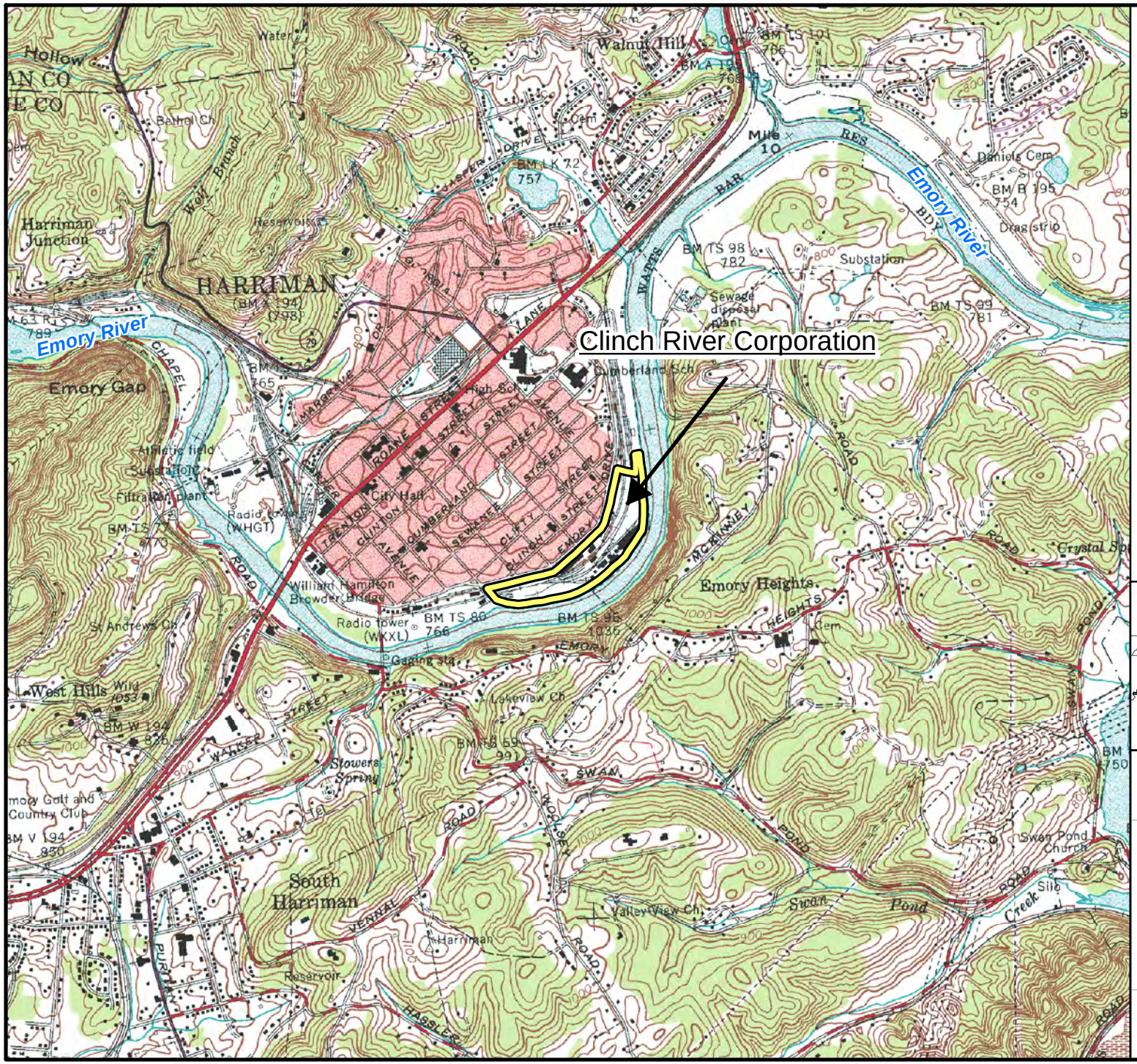
NS = Not scored

Table 4-1 –Surface Water Overland/Flood Migration Component Scoresheet			
Factor Categories and Factors	**Maximum Value**	**Value Assigned**	
Drinking Water Threat			
Likelihood of Release:			
1. Observed Release	550	550	
2. Potential to Release by Overland Flow:			
2a. Containment	10	NS	
2b. Runoff	10	NS	
2c. Distance to Surface Water	5	NS	
2d. Potential to Release by Overland Flow [lines 2a(2b + 2c)]	150	NS	
3.Potential to Release by Flood:			
3a. Containment (Flood)	10	NS	
3b. Flood Frequency	50	NS	
3c. Potential to Release by Flood (lines 3a x 3b)	500	NS	
4. Potential to Release (lines 2d + 3c, subject to a maximum of 500)	500	NS	
5. Likelihood of Release (higher of lines 1 and 4)	550		550
Waste Characteristics:			
6. Toxicity/Persistence	(a)	NS	
7. Hazardous Waste Quantity	(a)	NS	
8. Waste Characteristics	100		NS
Targets:			
9. Nearest Intake	50	NS	
10. Population:			
10a. Level I Concentrations	(b)	NS	
10b. Level II Concentrations	(b)	NS	
10c. Potential Contamination	(b)	NS	
10d. Population (lines 10a + 10b + 10c)	(b)	NS	
11. Resources	5	NS	
12. Targets (lines 9 + 10d + 11)	(b)		NS
Drinking Water Threat Score:			
13. Drinking Water Threat Score [(lines 5x8x12)/82,500, subject to a maximum of 100]	100		NS
Human Food Chain Threat			
Likelihood of Release:			
14. Likelihood of Release (same value as line 5)	550		550
Waste Characteristics:			
15. Toxicity/Persistence/Bioaccumulation	(a)	500,000,000	
16. Hazardous Waste Quantity	(a)	100	
17. Waste Characteristics	1,000		320
Targets:			
18. Food Chain Individual	50	45	

Table 4-1 –Surface Water Overland/Flood Migration Component Scoresheet (Continued)			
Factor Categories and Factors	**Maximum Value**	**Value Assigned**	
19. Population			
19a. Level I Concentrations	(b)	0	
19b. Level II Concentrations	(b)	0.03	
19c. Potential Human Food Chain Contamination	(b)	NS	
19d. Population (lines 19a + 19b + 19c)	(b)	0.03	
20. Targets (lines 18 + 19d)	(b)		45.03
Human Food Chain Threat Score:			
21. Human Food Chain Threat Score [(lines 14x17x20)/82500, subject to maximum of 100]	100		96.06
Environmental Threat			
Likelihood of Release:			
22. Likelihood of Release (same value as line 5)	550		550
Waste Characteristics:			
23. Ecosystem Toxicity/Persistence/Bioaccumulation	(a)	NS	
24. Hazardous Waste Quantity	(a)	NS	
25. Waste Characteristics	1,000		NS
Targets:			
26. Sensitive Environments			
26a. Level I Concentrations	(b)	NS	
26b. Level II Concentrations	(b)	NS	
26c. Potential Contamination	(b)	NS	
26d. Sensitive Environments (lines 26a + 26b + 26c)	(b)	NS	
27. Targets (value from line 26d)	(b)		NS
Environmental Threat Score:			
28. Environmental Threat Score [(lines 22x25x27)/82,500 subject to a maximum of 60]	60		NS
Surface Water Overland/Flood Migration Component Score for a Watershed			
29. Watershed Score[c] (lines 13+21+28, subject to a maximum of 100)	100		96.06
Surface Water Overland/Flood Migration Component Score			
30. Component Score (S_{sw})[c] (highest score from line 29 for all watersheds evaluated; subject to a maximum of 100)	100		96.06

Notes:

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer
NS Not scored



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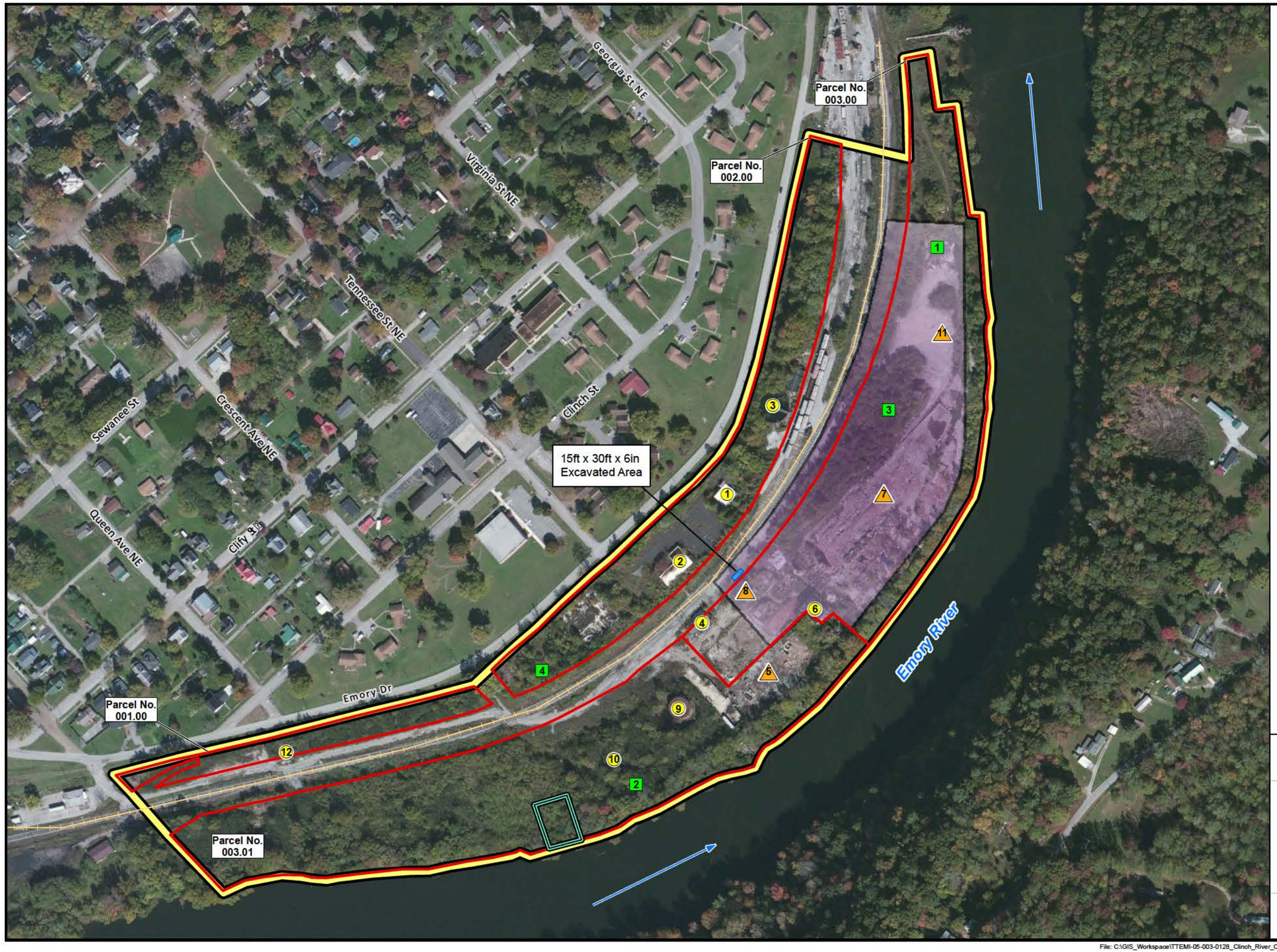

Legend

- 1 Main office
- 2 Training building
- 3 Clarifier
- 4 Time keeping building
- 5 Former location of boiler house
- 6 Steam generation and turbine building
- 7 Former location of the paper and pulp mill building
- 8 Former location of chipper shed (drum storage)
- 9 600,000-gallon AST
- 10 Black liquor pond
- 11 Former location of coal tar pond
- 12 Scale house
- # Waste paper pile
- Railroad
- Clinch River Corporation property boundary
- Flow direction
- Approximate location of south waste paper impoundment
- Parcel boundary
- Process area
- 15ft x 30ft x 6in Excavated Area

N W E S

0 125 250 Feet

1:3,000

Notes:
AST - Aboveground storage tank
Structure numbers have been revised for this HRS documentation record.

Map Source:
Bing Maps Aerial Imagery, 2012;
References 7, pp. 2, 5, 10, 12; 8, pp. 28, 29; 10, p. 6; 14, pp. 13, 14; 45, p. 2; 61, pp. 2, 3.

United States Environmental Protection Agency Region 4

FIGURE 2

Facility Layout

TDD Name: Clinch River Corporation

TDD No.: TTEMI-05-003-0128

City:	County:	State:
Harriman	Roane	Tennessee

TETRA TECH

Date 7/5/2012

Analyst ray.yeager

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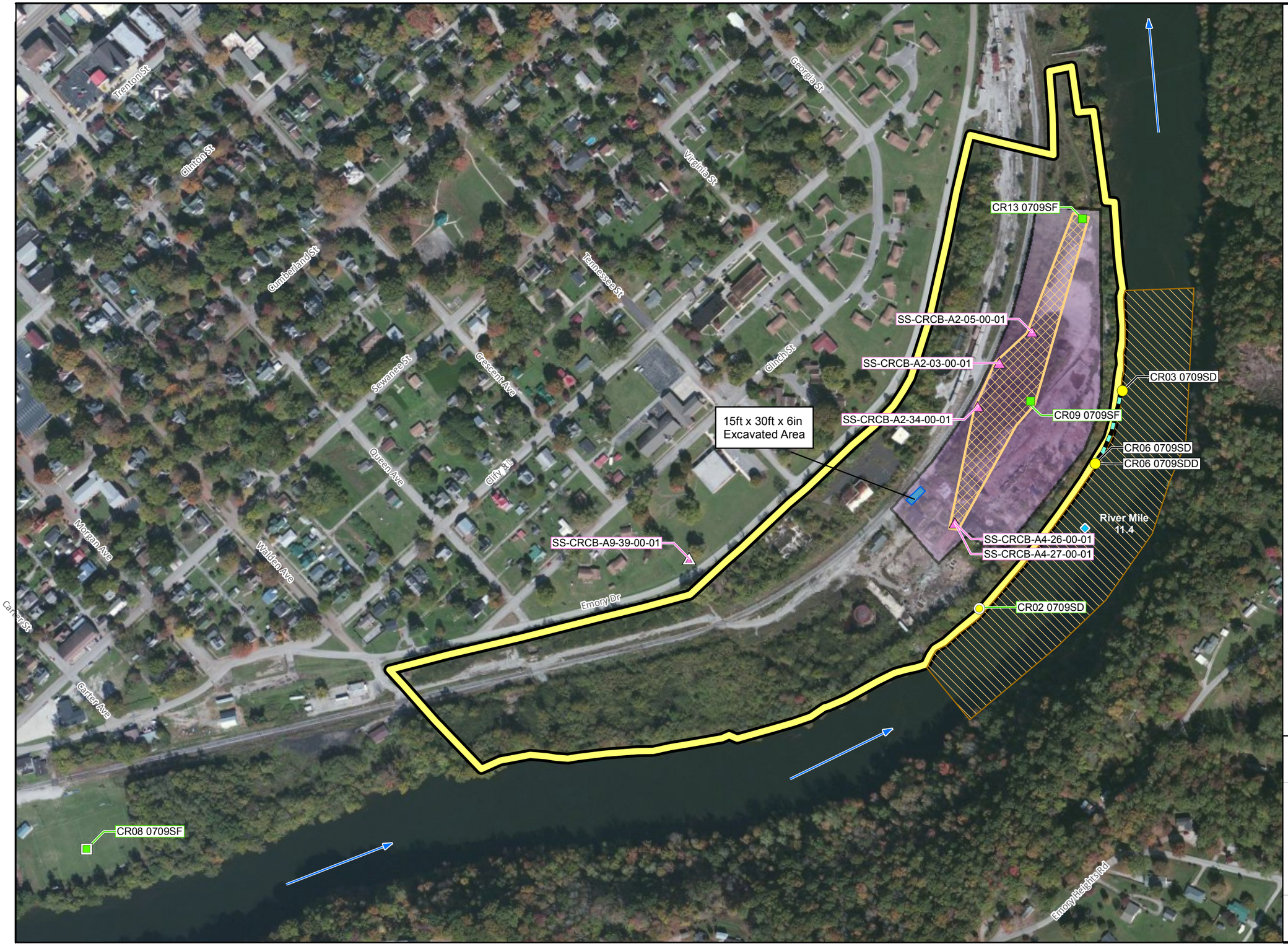

Legend

2009 TDEC Site Reassessment
- Observed Release Sediment Sample
- Background Sediment Sample
- Source Sample
- Background Soil Sample

2005 USACE Phase II Investigation
- Source Sample
- Background Soil Sample
- Emory River Mile Marker
- Probable Point of Entry (PPE)
- Process Area
- Flow direction
- Source No. 1
- Clinch River Corporation Property Boundary
- 15ft x 30ft x 6in Excavated Area
- Area of Fishing for Human Consumption

TDEC	Tennessee Department of Environment and Conservation
USACE	U.S. Army Corps of Engineers

Sample Identification Notes:

00-01	0 to 1 foot below ground surface
##	Sample number
A#	Area number
CR	Clinch River
CRCB	Clinch River Corporation Brownfields
SD	Sediment
SDD	Sediment duplicate
SF	Surface soil
SFD	Surface soil duplicate
SS	Surface soil

N
W E
S

0 150 300
Feet

Map Source:
Bing Maps Aerial Imagery, 2012;
Refs. 3; 8, pp. 30; 11, pp. 15, 21, 22, 116, 118, 120; 16, pp. 3, 4, 6, 7, 8; 57, p. 2; 61, pp. 2, 3.

United States Environmental Protection Agency Region 4

FIGURE 3
Source and Observed Release Samples

TDD Name: Clinch River Corporation

TDD No.: TTEMI-05-003-0128

City:	County:	State:
Harriman	Roane	Tennessee

TETRA TECH

Date: 8/14/2012

Analyst: ray.yeager

File: C:\GIS_Workspace\TTEMI-05-003-0128_Clinch_River_Corporation\GIS\MXDs\Source and Observed Release Maps\Fig3_Source_and_Observed_Release_Samples 8-14-12 RY.mxd

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67. Tetra Tech. Electronic Correspondence Between Sandra Harrigan, Tetra Tech, and Erin Sutton, Project Manager, TDEC DOR. Subject: Sample CR03 0709SD. July 22-23, 2012. 2 pages.

SITE DESCRIPTION

Clinch River Corporation (CRC) is located at 728 Emory Drive in Harriman, Roane County, Tennessee (References [Refs.] 5; 6, p. 1; see Figure 1 of this HRS documentation record). More specifically, the geographical coordinates, as measured at sample CR09 0709SF, collected within Source No. 1 and west of the former paper and pulp mill building, are latitude 35° 55' 55.02" north and longitude 84° 32' 21.77" west (Refs. 4; 8, p. 30; 16, p. 4). The EPA identification number, as recorded in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database, is TND987768587 (Ref. 5).

The CRC property is an inactive paper and pulp mill with several entrances along Emory Drive at Walden Street, Queen Street, and Tennessee Street (Ref. 8, p. 1). The CRC property consists of four parcels of land covering an area of about 29 acres (Refs. 7, pp. 1, 2, 3, 5, 6, 10, 11, 12; 8, pp. 1, 28). Several railroad tracks and easements traverse the CRC property from north to south (Ref. 8, p. 1; see Figures 1 and 2 of this HRS documentation record).

Parcel 001.00, located in the southwestern portion of the property, covers 1.3 acres and includes a scale house (Refs. 7, pp. 1, 2; 8, pp. 28, 29; 45, p. 2). Parcel 002.00, located in the northwestern portion of the property, covers 5.3 acres and includes a clarifier, a main office building, a training building (also referred to as a bath house), and a waste paper pile (referred to as "waste paper pile 4" in this HRS documentation record) (Refs. 7, pp. 3, 5; 8, pp. 28, 29; 10, pp. 6, 28; 45, p. 2; see Figure 2 of this HRS documentation record).

Parcel 003.00, located in the northeastern portion of the property, covers 10.48 acres and includes the former location of the paper and pulp mill building, the former location of an unlined surface impoundment (coal tar pond [ash pond]), a chipper shed and associated drum storage area, a steam generation and turbine building, a time keeping building, several aboveground storage tanks (AST), including a 15,000-gallon AST, a waste paper pile (referred to as "waste paper pile 1" in this HRS documentation record) located about 525 feet north of the former paper and pulp mill building, a waste paper pile (referred to as "waste paper pile 3" in this HRS documentation record) located about 100 feet northwest of the former paper and pulp mill building, and a concrete surface located north of the former paper and pulp mill building and near waste paper pile 1 (Refs. 7, pp. 6, 10; 8, pp. 28, 29, 34, 39; 10, pp. 5, 6, 51, 52, 55, 60; 45, pp. 2, 5, 8, 9, 10, 11; 61). The area where the former paper and pulp mill operations occurred will be referred to as the "process area" throughout this HRS documentation record (see Figure 2 of this HRS documentation record).

Parcel 003.01, located in the southeastern portion of the property, covers at least 12 acres and includes the former location of the boiler house, the former location of a south waste paper impoundment, a 600,000-gallon AST, an unlined surface impoundment (black liquor pond), and a waste paper pile (referred to as "waste paper pile 2" in this HRS documentation record) located adjacent to the black liquor pond (Refs. 7, pp. 11, 12; 8, pp. 28, 29; 10, p. 6; 45, p. 2; see Figures 1 and 2 of this HRS documentation record).

The CRC property is overgrown with dense vegetation in some locations and is not secure (Refs. 8, p. 1; 10, p. 8). Land uses surrounding the CRC property are predominantly residential and light industrial (Refs. 8, p. 28). The CRC property is bordered to the north by industrial properties, to the east and south by the Emory River, and to the west by Emory Drive and residential properties beyond (Ref. 8, pp. 1, 28; see Figure 2 of this HRS documentation record).

For HRS scoring purposes, the site consists of one source and associated releases to the surface water migration pathway. Source No. 1 consists of contaminated soil from discrete operations (e.g., disposal practices) around the process area (Refs. 8, pp. 2, 14 through 21, 28, 29; 10, p. 6; 11, pp. 33, 38 through 42, 47, 48, 49; see Figure 3 of this HRS documentation record). Hazardous substances including anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(k)fluoranthene; carbazole; chrysene; dibenzo(a,h)anthracene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; 2-methlynaphthalene; naphthalene; phenanthrene; pyrene; 1,2,3,4,6,7,8-heptachlorodibenzodioxin (HpCDD); 1,2,3,4,6,7,8-heptachlorodibenzofuran (HpCDF); 1,2,3,4,7,8-hexachlorodibenzodioxin (HxCDD); 1,2,3,6,7,8-HxCDD;

1,2,3,7,8,9-HxCDD; cadmium; chromium; copper; lead; manganese; mercury; nickel; silver; and zinc have been detected in Source No. 1 (see Section 2.2.1 of this HRS documentation record).

These hazardous substances have also been documented in sediment samples collected from the Emory River, which receives runoff from Source No. 1, indicating that a release has occurred to the surface water migration pathway (see Section 4.0 of this HRS documentation record).

OPERATIONAL AND REGULATORY HISTORY

From 1929 to 2002, a paper and pulp mill operated on the CRC property (Refs. 8, p. 2; 10, pp. 4, 5; 14, pp. 22, 315). The following companies owned and/or operated the paper and pulp mill throughout its operational history: the Mead Corporation, Inc.; the Harriman Paperboard Corporation; the Clinch River Corporation; the Gibson Group; Mid-South Cogeneration, Inc.; Power Paper, Inc.; Power Paper, Limited; Power Paper Recycling, Inc.; and American Kraft Mills of Tennessee, LLC (Refs. 10, pp. 4, 5, 6, 7, 286 through 298; 14, pp. 190, 196, 200). Of the four parcels that make up the CRC property, three are currently owned by the Gibson Group and one is currently owned by Dr. Clary P. Foote (Ref. 7, pp. 1, 2, 3, 5, 6, 10, 11, 12).

Former operations on the CRC property included manufacturing nonbleached corrugated containers using paperboard from pulp production (Ref. 14, pp. 8, 256, 280, 315). The manufacturing process included partially digesting raw hardwood chips with sodium sulfite, sodium carbonate, and live steam. The wood chips were further refined using a mechanical pulping process (Refs. 10, p. 6; 14, pp. 8, 211, 280, 400; 44, p. 10). The virgin paper stock was then mixed with recycled paper stock at a rate of 75 percent virgin to 25 percent recycled. The blended paper stock was allowed to dry in mats that were cut into customer-specific widths (Ref. 14, p. 211).

By-products of the paper manufacturing process included paper waste, black liquor (spent processing waste), and coal tar constituents (Refs. 10, p. 6; 11, p. 6; 14, p. 8). The treatment of the paper waste consisted of primary clarification after the material was screened through a 3-millimeter mesh screen. One half of the waste stream (sludge) generated by the clarifier was recycled back into the plant, while the other half (mill effluent) was discharged to the Tennessee River through the Harriman Sewage Treatment Plant system. Skimmer waste from the clarifier was disposed of on the CRC property (Ref. 14, pp. 211, 216). Waste paper was also disposed of in piles throughout the CRC property (Refs. 10, p. 6; 11, p. 7; 14, pp. 8, 169 through 178, 182, 183, 185).

Black liquor can be composed of phenols, sodium hydroxide, sodium oxide, and sulfur; as well as metals, such as calcium and magnesium (Refs. 10, p. 6; 14, p. 8). Coal tar consists of polynuclear aromatic hydrocarbons (PAH), phenols, heterocyclic oxygen, sulfur, and nitrogen compounds (Refs. 9, p. 220; 14, p. 8; 30, pp. 9, 21). Dioxins, furans, PAHs, and metals, such as chromium, copper, and manganese, can also be produced as by-products of the paper manufacturing process (Refs. 49, p. 7; 51, p. 10; 54, pp. 1-1, 3-3, 3-4, 3-7, 3-8, 3-11; 55, pp. 1, 2). Black liquor and coal tar wastes were disposed of on the CRC property in two unlined surface impoundments (the black liquor pond and the former coal tar pond) and in drums (Refs. 10, p. 31; 11, pp. 7, 11; 14, pp. 8, 155).

Paper and pulp mill processes generated effluents from pulp operations, paper board operations, and supporting auxiliaries. The pulp operations waste stream received only the dilute solutions of constituents extracted from the wood that could be reused in the pulping operations. The paper board operation waste stream consisted of excess white water (filtrate) from the paper machine water slurry. The supporting auxiliary waste stream consisted of chemicals used for conditioning boiler feed water by the ion exchange method (Ref. 14, p. 316).

Wastes from paper mill operations were disposed of on the CRC property (Refs. 10, p. 6; 14, pp. 155, 156, 157, 169 through 183, 185). Multiple waste areas have been identified on the CRC property. These areas include: (1) an unlined surface impoundment (black liquor pond), located on the southern portion of the property; (2) an unlined surface impoundment (former coal tar pond), located on the northeastern side of the property; (3) waste paper pile 1, located about 525 feet north of the former paper and pulp mill

building; (4) waste paper pile 2, located adjacent to the black liquor pond; (5) waste paper pile 3, located about 100 feet northwest of the former paper and pulp mill building; and (6) waste paper pile 4, located on a concrete slab inside a fenced enclosure on the southern portion of Parcel 002.00 (Refs. 8, p. 29; 10, p. 6; 14, pp. 155, 169 through 183, 185). Waste paper pile 3 was removed in the 1990s and its former location was subsequently paved with concrete. The fencing around waste paper pile 4 was removed and the pile was covered with soil (Ref. 10, p. 6).

The Emory River was the source of fresh water for mill operations. The receiving streams were the Emory and Tennessee Rivers (Ref. 14, pp. 315, 337, 338). In 1957, Mead Corporation began discharging effluent through the City of Harriman's sewer system (Ref. 14, pp. 278, 400). In 1971, Mead Corporation maintained 12 outfalls into the Emory River and one outfall into the Tennessee River (Ref. 14, pp. 303 through 306). Outfall 001 received process effluent that was mixed with the Harriman's Utility Board Waste Treatment Plant effluent and discharged through a diffuser into the Tennessee River, approximately 15.7 miles downstream of the CRC property (Refs. 3; 14, p. 304). Outfall 002 (surface drains in debarking area), Outfall 003 (drain from small laboratory), Outfall 004 (septic tank outfall), Outfall 005 (drain from chemical storage area), Outfall 006 (bearing and machine cooling water), Outfall 007 (emergency overflow from mill process water), Outfall 008 (storm water runoff from the mill area), Outfall 009 (turbine room roof drainage), Outfall 010 (boiler feed water conditioning area), Outfall 011 (sand filter backwash), Outfall 012 (boiler house area), and Outfall 013 (boiler mud drum) discharged into the Emory River (Ref. 14, pp. 304, 305, 306).

In June 1974, Mead Corporation was issued National Pollutant Discharge Elimination System (NPDES) permit TN0001627 from EPA as well as a temporary discharge permit from the State; however, the details of the permits are not known (Ref. 14, p. 277). In June 1974, just prior to receiving this permit, Mead Corporation stated that it had already tied Outfalls 002, 003, 004, 005, and 006 to Outfall 001, and planned to tie Outfalls 010, 011, 012, and 013 to Outfall 001 by 1976. Furthermore, Outfall 007 was no longer in use, and Outfalls 008 and 009 were storm drains that Mead did not intend to connect to Outfall 001. Mead also stated its intention to install a primary clarifier on the CRC property by 1976, in advance of the date on which the City of Harriman's secondary treatment system would be completed (Ref. 14, pp. 300, 301).

The NPDES permit was renewed in 1983 and allowed sanitary and process wastewater from Outfall 001 to be discharged to the City of Harriman sewage treatment plant system (Ref. 14, pp. 268, 270, 337, 338). In 1988, CRC was issued NPDES permit TN0062383 authorizing discharge of noncontact cooling water and storm water runoff to the Emory River at mile 11.4, which is about 250 feet from Source No. 1, and about 211 feet from the observed release (Ref. 14, pp. 236, 237, 250, 257, 261; see Figure 3 and Section 4.1.2.1.1 of this HRS documentation record). An estimated 400,000 gallons of effluent was discharged into the Emory River per day (Ref. 14, p. 259). Previously, process wastewater was discharged to the Tennessee River through NPDES permit TN0001627; however, NPDES permit application TN0062383 stated that the process wastewater would be recycled (Ref. 14, pp. 249, 250, 261, 268, 270). The permit did not require monitoring of specific constituents (Ref. 14, pp. 237, 238).

Several spills, releases, and NPDES permit violations have been documented throughout the facility's operational history. Between 1988 and 1989, the facility illegally discharged process water, cooling water, and waste paper wash runoff into the Emory River (Ref. 14, pp. 345, 354, 357, 359, 361, 367). Discoloration (black and gray) of the Emory River directly adjacent to and downstream of the CRC property was also documented during this period (Ref. 14, pp. 354, 360, 362). The CRC property flooded in 1990, and as a result, waste paper, black liquor, and coal tar wastewater were deposited into the Emory River (Ref. 14, pp. 8, 159 through 161, 164 through 166, 186, 187). During the 1991 TDHE site inspection, TDHE observed (1) black liquor and coal tar leaching into the Emory River from the CRC property below the water line, and (2) that the south waste paper impoundment had partially collapsed into the Emory River, dumping waste paper and waste paper rolls into the river (Ref. 14, pp. 8, 14, 16, 165 through 168, 186, 187). In June 2002, the owner of Parcel 003.01 was convicted of intentionally releasing approximately 500,000 gallons of process liquid containing black liquor and solids, the contents of an AST, onto the ground and into the Emory River on February 14, 1999, during a period of heavy rains (Refs. 7, p. 11; 46, p. 1; 47, p. 11; 62, p. 17).

Paper and pulp mill effluent can contain PAHs; dioxins and furans; and metals (Refs. 49, p. 7; 51, p. 10; 54, pp. 1-1, 3-7, 3-8, 3-11). PAHs are contained in coal tar (Refs. 9, p. 220; 14, p. 8; 30, pp. 9, 21). Dioxins and furans accumulate in the pulp and are chemicals of concern in wastewater treatment sludge and in liquid (re-pulped) effluent (Ref. 50, pp. 6, 10). Metals, such as cadmium, chromium, copper, lead, mercury, nickel, and zinc can be contained in effluent and in pulp mill sludge (Refs. 50, p. 10; 51, pp. 1, 2, 3; 54, pp. 1-1, 3-11).

PREVIOUS INVESTIGATIONS

From 1984 to 2012, numerous investigations were conducted at the CRC property. Table 1 lists some of the previous sampling investigations, including the paper and pulp mill-related hazardous substances detected in the samples collected.

TABLE 1: Summary of Previous Investigations

Agency	Investigation	Date	Samples Collected	Chemicals of Concern Detected	References
TDHE	Acute Toxicity Study	1984	Process waste water discharge	Phenols	14, pp. 9, 211 through 214, 218
TDHE	Site Investigation	1991	Soil, surface water, and sediment	Chromium Copper Lead Manganese Mercury Nickel Zinc	14, pp. 6, 16, 63, 64, 80, 81
Halliburton NUS Corporation for EPA	Expanded Site Inspection	1993	Surface and subsurface soil, sediment	Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(b,k)fluoranthene Carbazole Chrysene Dibenzo(a,h)anthracene Fluoranthene Fluorene Indeno(1,2,3-cd)pyrene 2-Methylnaphthalene Naphthalene Phenanthrene Pyrene Cadmium Chromium Copper Lead Manganese Mercury Nickel Zinc	13, pp. 1, 8, 10, 11, 12, 16 through 20, 22, 24, 25
Shaw Environmental for TDEC DOR	Phase I ESA	2005	None	None	10, pp. 1, 38 through 41

TABLE 1: Summary of Previous Investigations					
Agency	**Investigation**	**Date**	**Samples Collected**	**Chemicals of Concern Detected**	**References**
USACE	TBA Phase II Investigation	2005	Surface and subsurface soil	Cadmium Chromium Copper Manganese Mercury Nickel Silver Zinc	11, pp. 4, 13, 14, 38, 39, 47
TDEC DOR	Site Reassessment	2009	Soil, surface water, and sediment	Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(k)fluoranthene Carbazole Chrysene Dibenzo(a,h)anthracene Fluoranthene Fluorene Indeno(1,2,3-cd)pyrene 2-Methylnaphthalene Naphthalene Phenanthrene Pyrene 1,2,3,4,6,7,8-HpCDD 1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD Cadmium Chromium Copper Lead Mercury Nickel Zinc	8, pp. i, ii, 3, 14, 15, 17 through 21
TDEC DOR	Expanded Site Investigation	2010	Fish tissue	Chromium Copper Zinc	12, pp. i, 1, 3, 6, 7, 15
OTIE for EPA	Emergency Response	2011	Waste	Benzo(a)pyrene Naphthalene	52, p. 3; 59, pp. 1, 4, 5, 6
OTIE for EPA	Removal Assessment	2012	Surface and subsurface soil	Benzo(a)anthracene Benzo(a)pyrene Dibenzo(a,h)anthracene	60, pp. 1, 3, 4

Notes:

CRC	Clinch River Corporation
DOR	Division of Remediation
ESA	Environmental Site Assessment
HpCDD	Heptachlorodibenzodioxin
HpCDF	Heptachlorodibenzofuran
HxCDD	Hexachlorodibenzodioxin
OTIE	Oneida Total Integrated Enterprises
PAH	Polynuclear aromatic hydrocarbon
SVOC	Semivolatile Organic Compounds
TBA	Targeted Brownfield Assessment
TDEC	Tennessee Department of Environment and Conservation
TDHE	Tennessee Department of Health and Environment
USACE	U.S. Army Corps of Engineers
VOC	Volatile Organic Compounds

In 2005, the Tennessee Department of Environment and Conservation (TDEC, previously TDHE) Division of Remediation (DOR) tasked Shaw Environmental, Inc. (Shaw) with conducting a Phase I Environmental Site Assessment (ESA) at CRC (Ref. 10, p. ES-1). During site reconnaissance activities, about 106 damaged, leaking, or open containers (55-gallon drums and two 250-gallon totes) containing various oily liquid wastes were observed in and around the chipper shed. The oily liquid wastes were suspected to contain lubricant oils, white paper and black paper liquor waste, water, and other waste. Notable dark staining was observed in the area near the leaking containers (Ref. 10, pp. 39, 51, 52). Erosion of the concrete surface near waste paper pile 1 revealed layers of dark staining in the soils underneath the concrete surface. This area of concrete erosion and staining borders the Emory River and is prone to flooding (Refs. 10, p. 39; 23; 24, p. 1). In addition, distressed vegetation was observed near waste paper pile 1 (Ref. 10, pp. 40, 59; see Figure 2 of this HRS documentation record). Shaw recommended that a Phase II ESA be conducted (Ref. 10, p. 40).

In 2005, the U.S. Army Corps of Engineers (USACE) was tasked by EPA to conduct a Targeted Brownfield Assessment (TBA) Phase II Investigation at the CRC property (Ref. 11, p. 4). Surface and subsurface soil samples were collected throughout the CRC property (Ref. 11, pp. 11, 13, 14). The samples contained semivolatile organic compounds (SVOCs), including PAHs; dioxins and furans; and metals (Refs. 11, pp. 38 through 42, 47, 48, 49; 54, pp. 3-7, 3-8).

In 2009, TDEC DOR conducted a site reassessment at the CRC property (Ref. 8, p. i). Surface soil, surface water, and sediment samples were collected during the reassessment (Ref. 8, p. 3). Surface soil samples contained dioxins and furans; PAHs; and arsenic at concentrations above background levels (Ref. 8, pp. 9, 15, 18, 20, 21). The same constituents were also detected in sediment samples collected from the Emory River directly adjacent to the CRC property (Ref. 8, pp. 6, 7, 8, 14, 15, 17, 19, 20).

In September 2010, TDEC DOR conducted an expanded site investigation (ESI), which involved collection of 32 fish (four largemouth bass, 25 sunfish, and three carp) from the Emory River at three locations downstream of the CRC property (Ref. 12, pp. i, 3). A fish tissue sample was not collected upstream of the CRC property; however, analytical data from the fish tissue samples were compared to average concentrations from the Watts Bar Reservoir, obtained from a biological database maintained by the Division of Water Pollution Control within TDEC (Ref. 12, pp. 4, 6). The fish tissue samples contained polychlorinated biphenyls, benzaldehyde, chromium, copper, and zinc (Ref. 12, pp. 6, 15). Copper and chromium levels in the collected fish tissue both exceeded the historical average background levels, with copper exceeding three times the historical average background concentration (Ref. 12, pp. 6, 7).

In August 2011, EPA conducted an assessment of the leaking drums in the drum storage area and of the 600,000-gallon AST located on parcel 003.01 (Ref. 52, pp. 2, 3). Field testing indicated that the drums contained liquid acids, liquid and solid bases, flammable liquids, and natural liquids (Refs. 52, p. 3; 59, pp. 3, 4). Approximately 20 cubic yards of spilled material were observed in the drum storage area (Ref. 52, p. 3).

In September 2011, EPA initiated an emergency removal action to stabilize the leaking drums located in the drum storage area. The drums were stabilized and disposed of in February 2012 (Refs. 45, p. 22; 52, p. 3; 53, p. 1; 59, p. 5). Stained surface soil directly surrounding the drums located in the drum storage area was removed (Refs. 53, p. 1; 59, pp. 5, 28; 61, p. 1). No other areas on the CRC property were excavated (Ref. 61, p. 1).

EPA removal activities continued in February 2012 and included removing all drums and containers, excavating an underground storage tank (UST), collecting surface and subsurface soil samples, and advancing borings to install temporary monitoring wells (Refs. 45, pp. 19, 22, 26; 53, pp. 1, 2; 60, p. 3; 61, p. 1). The UST, located southeast of the former paper and pulp mill building, contained approximately 38,500 gallons of black liquor. Once the UST was removed, black liquor and associated sludge were observed in the tank pit. This material was removed; however, about 6 inches of water containing black liquor was noted seeping into the excavated tank pit (Refs. 45, pp. 19, 21, 22, 24, 26; 53, pp. 1, 2). Surface soil samples were collected from 21 locations throughout the CRC property. Specifically, samples were collected near waste paper pile 1, north and southeast of the former mill building, near the chipper shed, near the black liquor pond, near waste paper pile 2, and in the wooded area of parcel 003.01 (Ref. 53, pp. 1, 2; 60, p. 9; see Figure 2 of this HRS documentation record). A soil boring was advanced through the concrete at the former location of the coal tar pond to a depth of 35 feet bgs. Black liquor was observed in the boring (Ref. 45, pp. 1, 19, 21). The surface and subsurface soil samples contained PAHs and arsenic. More specifically, benzo(a)anthracene was detected up to 2,300 µg/kg (micrograms per kilogram); benzo(a)pyrene was detected up to 2,000 µg/kg; benzo(b)fluoranthene was detected at 2,200 µg/kg; dibenzo(a,h)anthracene was detected up to 440 µg/kg; and arsenic was detected at 54 mg/kg (milligrams per kilograms) (Ref. 60, pp. 4, 10).

As of June 2012, the emergency response actions are complete; however, the removal action is on-going. No drums containing waste remain on the CRC property. The chipper shed is no longer standing. Three empty ASTs remain on the CRC property. EPA is in the process of working with Dr. Foote and other potentially responsible parties to empty and dismantle the 600,000-gallon AST and to conduct further soil testing. An expected completion date has not been established (Ref. 61, p. 1). Samples evaluated for Source No. 1 were not impacted by EPA removal activities (Refs. 53, p. 1; 61, pp. 1, 2, 3), and no removal has occurred at the zone of contamination in the Emory River (see Section 4.1.2.1.1 of this HRS documentation record). At the time this HRS documentation record submittal, the status of the removal action remained unchanged.

2.2 SOURCE CHARACTERIZATION

2.2.1 SOURCE IDENTIFICATION

Number of source: 1

Name of source: Contaminated soil resulting from discrete operations (e.g., disposal practices) around the process area

Source Type: Contaminated Soil

Description and Location of Source (with reference to a map of site):

Source No. 1 is an area of contaminated soil resulting from paper manufacturing operations (e.g., disposal practices) around the process area. Specifically, composite samples used to characterize Source No. 1 were collected in the vicinity of (1) waste paper pile 1 (north of the former paper and pulp mill building), (2) waste paper pile 3 (northwest of the former paper and pulp mill building), and (3) the western wall of the steam generation and turbine building (Refs. 8, pp. 9, 14 through 21, 29, 30; 10, pp. 6, 47; 11, pp. 15, 16, 21, 38 through 42, 47, 48, 49; see Figures 2 and 3 of this HRS documentation record). Soil samples contained overlapping hazardous substances related to facility processes, each sample was collected from within the paper manufacturing operations process area and from the same source type (contaminated soil) and containment features, and each sample drains into the same surface water pathway (Refs. 8, p. 6; 8, pp. 1, 2, 6, 30, 33, 34, 35; 10, pp. 6, 33, 39, 40; 14, pp. 164 through 174, 186, 187; 39; see Figure 3 and Sections 2.2.2 and 2.2.3 of this HRS documentation record).

From 1929 to 2002, a paper and pulp mill facility operated on the CRC property (Refs. 8, p. 2; 10, pp. 4, 5; 14, pp. 22, 315). By-products of the paper manufacturing process included black liquor (spent processing waste), coal tar constituents, and waste paper (Refs. 10, p. 6; 11, p. 6; 14, p. 8). Black liquor can be composed of phenols, sodium hydroxide, sodium oxide, and sulfur; as well as metals, such as calcium and magnesium (Refs. 10, p. 6; 14, p. 8; 29, p. 19). Coal tar consists of PAHs, phenols, heterocyclic oxygen, sulfur, and nitrogen compounds (Refs. 9, p. 220; 14, p. 8; 30, pp. 9, 21). Dioxins, furans, PAHs, and metals, such as chromium, copper, and manganese, can also be produced as by-products of the paper manufacturing process (Refs. 49, p. 7; 51, p. 10; 54, pp. 1-1, 3-3, 3-4, 3-7 through 3-11; 55, pp. 1, 2). These by-products were disposed of on the CRC property (Refs. 10, p. 31; 14, pp. 8, 155, 169 through 181).

Surface and subsurface soil samples were collected from Source No. 1 during the 2005 USACE TBA Phase II investigation and the 2009 TDEC site reassessment (Refs. 8, pp. 9, 29, 30; 11, pp. 4, 13, 14). The samples contained PAHs; dioxins and furans; and metals at concentrations greater than background levels (Ref. 8, pp. 15, 18, 20, 21; 11, pp. 38 through 42, 47, 48, 49; 40, p. 3-8) (see Tables 2 and 3 of this HRS documentation record). Samples evaluated for Source No. 1 were not impacted by EPA removal activities (Refs. 53, p. 1; 61, pp. 1, 2, 3).

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

2005 USACE TBA Phase II Investigation

USACE collected the surface soil samples listed in Table 2 during the 2005 TBA Phase II Investigation (Ref. 11, pp. 15, 16, 17). Composite surface soil sample SS-CRCB-A9-39-00-01 was chosen to represent background conditions because (1) the soil type at sample location SS-CRCB-A9-39-00-01 (loam) was similar to the soil types at the locations of samples collected from Source No. 1 (loam), and (2) this sampling location (a community center) appeared to be minimally affected by past facility operations (Refs. 11, pp. 17, 22; 20, pp. 1, 4; 28, pp. 1, 4; see Figure 3 of this HRS documentation record). Source No. 1 samples were collected from the process area (Ref. 11, pp. 15, 16, 21). Specifically, three composite surface soil samples (SS-CRCB-A2-03-00-01, SS-CRCB-A2-05-00-01, and SS-CRCB-A2-34-00-01) were collected adjacent to waste paper pile 3 located northwest of the former paper and pulp mill building, and two composite surface soil samples (SS-CRCB-A4-26-00-01 and SS-CRCB-A4-27-00-01) were collected near the western wall of the steam generation and turbine building (Refs. 10, p. 47; 11, pp. 15, 16, 21). The samples were collected using stainless steel hand augers (Refs. 11, p. 13; 25, pp. 28, 34). The background and contaminated composite surface soil samples were collected at a depth of 0 to 1 foot below ground surface (bgs) (Refs. 11, p. 13; 25, p. 40).

Background and Source No. 1 surface soil samples were collected during the same sampling event, from the same depth (0 to 1 foot bgs), from similar soil types (loam), and in accordance with the same sampling procedures (Refs. 11, pp. 4, 13, 15, 16, 17; 20, pp. 1, 4; 25, pp. 28, 31, 40; 28, pp. 1, 4). The surface soil samples were collected in accordance with the EPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), May 1996, including 1997 revisions and the EPA approved the quality assurance project plan (QAPP) (Refs. 11, pp. 4, 12; 25, p. 37; 26, p. 3).

The samples were analyzed for trace inductively coupled plasma (ICP) metals (EPA Method 6010B) and mercury (EPA Method 7470/7471) by Severn Trent Laboratories, Inc. (STL) (Refs. 11, pp. 130, 131, 132, 141; 25, p. 32; 27, pp. 1, 1A, 2, 3; 40, pp. 1, 2, 3). Bhate Environmental, subcontractor for USACE, reviewed all data in accordance with the EPA National Functional Guidelines for Inorganic Data Review, EPA 540/R-99/013 (Refs. 11, pp. 12, 18).

The reporting limits (RLs) are listed on the analytical data sheets in References 27 and 40. Each RL is sample-specific and analyte-specific and corresponds to the lowest quantitative point on the calibration curve; it is adjusted for the amount of sample prepared and any dilutions performed, as well as for percent moisture. The RLs are equivalent to SQLs as defined in HRS Section 1.1, Definitions (Refs. 1, Section 1.1; 58). Logbook notes are provided in Reference 11, Appendix B. The chain-of-custody records are provided in Reference 11, Appendix C. The locations of the samples are depicted in Reference 11, pages 21and 22, and are described in Reference 11, pages 15, 16, and 17 (see Figure 3 of this HRS documentation record).

TABLE 2: Analytical Results for Source No. 1 Samples – 2005

Sample ID	Hazardous Substance	Hazardous Substance Concentration	RL	References
Background Surface Soil Sample				
SS-CRCB-A9-39-00-01	Chromium	34.7 mg/kg	1.2 mg/kg	11, pp. 114, 132; 40, p. 1299
SS-CRCB-A9-39-00-01	Copper	22.2 mg/kg	3.1 mg/kg	11, pp. 114, 132; 40, p. 1299
SS-CRCB-A9-39-00-01	Manganese	836 mg/kg	1.8 mg/kg	11, pp. 114, 132; 40, p. 1300
SS-CRCB-A9-39-00-01	Mercury	0.37 mg/kg	0.041 mg/kg	11, pp. 114, 132; 40, p. 1300

TABLE 2: Analytical Results for Source No. 1 Samples – 2005				
Sample ID	**Hazardous Substance**	**Hazardous Substance Concentration**	**RL**	**References**
SS-CRCB-A9-39-00-01	Silver	ND	1.2 mg/kg	11, pp. 114, 132; 40, p. 1300
Contaminated Surface Soil Samples				
SS-CRCB-A2-03-00-01	Chromium	988 mg/kg	1.7 mg/kg	11, pp. 106, 131; 27, p. 1195
SS-CRCB-A2-03-00-01	Copper	131 mg/kg	4.2 mg/kg	11, pp. 106, 131; 27, p. 1195
SS-CRCB-A2-03-00-01	Manganese	9,400 mg/kg	25.1 mg/kg	11, pp. 106, 131; 17, pp. 8, 18; 18, pp. i, 1; 27, p. 1196; 56, p. 17
SS-CRCB-A2-03-00-01	Silver	18.6 mg/kg	1.7 mg/kg	11, pp. 106, 131; 27, p. 1196
SS-CRCB-A2-05-00-01	Silver	9.3 mg/kg	1.5 mg/kg	11, pp. 106, 130; 27, p. 1192
SS-CRCB-A2-34-00-01	Copper	122 mg/kg	6.2 mg/kg	11, pp. 106, 130; 27, p. 1189
SS-CRCB-A4-26-00-01	Copper	126 mg/kg	3.0 mg/kg	11, pp. 109, 130; 27, p. 1173
SS-CRCB-A4-26-00-01	Mercury	1.4 mg/kg	0.039 mg/kg	11, pp. 109, 130; 27, p. 1174
SS-CRCB-A4-27-00-01	Copper	131 mg/kg	6.1 mg/kg	11, pp. 109, 130; 27, p. 1171

Notes:

00-01	0 to 1 foot below ground surface (Ref. 11, p. 13)
##	Sample Number
A#	Area Number
CRCB	Clinch River Corporation Brownfields
ID	Identification
mg/kg	Milligrams per kilogram
ND	The analyte was not detected at or above the reporting limit (Ref. 40, p. 3)
SS	Surface soil
RL	Reporting limit

2009 TDEC Site Reassessment

The surface soil samples listed in Table 3 were collected by TDEC during the 2009 site reassessment (Ref. 8, p. 9). Composite surface soil sample CR08 0709SF was chosen to represent background conditions because (1) the soil type at sample location CR08 0709SF (loam) was similar to the soil types at the locations of samples collected from Source No. 1 (loam), and (2) the sampling location (a baseball field) appeared minimally affected by past facility operations (Refs. 8, pp. 9, 30, 36, 359; 28, pp. 1, 4; 41, pp. 1, 4; see Figure 3 of this HRS documentation record). Source No. 1 samples were collected from the process area (Ref. 8, pp. 28, 30, 359). Specifically, one composite surface soil sample (CR09 0709SF) was collected west of the former paper and pulp mill building near waste paper pile 3; and one composite surface soil sample (CR13 0709SF) was collected near waste paper pile 1 (Refs. 8, pp. 9, 29, 30). The background and contaminated composite surface soil samples were collected at a depth of 0 to 2 inches bgs (Ref. 39). In September 2011, EPA initiated an emergency removal action. Stained surface soil directly surrounding the drums located in the drum storage area was removed, which affected sampling location CR11 0709SF from the 2009 TDEC site reassessment (Refs. 53, p. 1; 59, pp. 5, 28; 61, p. 1). This sampling location is not used in this HRS documentation record.

Background and Source No. 1 composite surface soil samples were collected during the same sampling event, from the same depth (0 to 2 inches bgs), from similar soil types (loam), and in accordance with the same sampling procedures (Refs. 8, pp. 9, 27, 359; 28, pp. 1, 4; 39; 41, pp. 1, 4). The background and contaminated composite surface soil samples were collected in accordance with the EPA approved TDEC sampling and analysis plan (SAP) and QAPP, specifically the EPA Region 4 Science and Ecosystem Support Division (SESD) Field Branches Quality System and Technical Procedures (FBQSTP) for Soil Sampling, SESDPROC-300-R1 (Refs. 8, pp. 327, 346, 359; 39).

The background and source samples were analyzed for SVOCs, dioxins, and metals (Ref. 8, p. 3). SVOC analysis (EPA Methods 8270D and 8270SIM) was conducted by the EPA Region 4 SESD Analytical Support Branch (ASB) in accordance with the ASB Laboratory Operations and Quality Assurance Manual (LOQAM) (Ref. 8, pp. 3, 95). EPA Region 4 SESD reviewed SVOC data in accordance with the ASB LOQAM, EPA methods and guidelines (Refs. 8, p. 95). Dioxins were analyzed by SGS Environmental Services in accordance with the EPA Contract Laboratory Program (CLP) Statement of Work (SOW) DLM02.0 (Ref. 8, pp. 3, 50, 51). Total metals were analyzed by CompuChem, currently known as Liberty Analytical Corporation (Liberty), in accordance with the EPA CLP SOW ILM05.3 (Ref. 8, pp. 272, 273, 304, 306, 316). EPA Region 4 SESD reviewed dioxin and total metals data in accordance with the contract SOW and EPA guidelines (Refs. 8, pp. 3, 50, 51, 272, 273).

The minimum reporting limits (MRLs) are listed on the analytical data sheets in Reference 8, Appendix 1. Each MRL is sample-specific and analyte-specific and corresponds to the lowest quantitative point on the calibration curve; it is adjusted for the amount of sample prepared and any dilutions performed, as well as for percent moisture (Ref. 15). The MRLs are equivalent to SQLs as defined in HRS Section 1.1, Definitions (Refs. 1, Section 1.1; 8, pp. 53, 98, 277; 15). Logbook notes are provided in Reference 16. The chain-of-custody records are provided in References 64, 65, and 66. The locations of the samples listed in Table 3 are depicted in Reference 8, page 30, and are described in Reference 8, page 9 (also see Figure 3 of this HRS documentation record).

TABLE 3: Analytical Results for Source No. 1 Samples –2009

Sample ID	Hazardous Substance	Hazardous Substance Concentration	MRL	References
Background Surface Soil Sample				
CR08 0709SF	Anthracene	3.8U µg/kg	3.8 µg/kg	8, p. 120; 16, p. 3; 64, p. 2
CR08 0709SF	Benzo(a)anthracene	7.3 µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2

TABLE 3: Analytical Results for Source No. 1 Samples –2009				
Sample ID	**Hazardous Substance**	**Hazardous Substance Concentration**	**MRL**	**References**
CR08 0709SF	Benzo(a)pyrene	6.6 µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2
CR08 0709SF	Benzo(k)fluoranthene	4.2 µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2
CR08 0709SF	Carbazole	3.8U µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2
CR08 0709SF	Chrysene	8.9 µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2
CR08 0709SF	Dibenzo(a,h)anthracene	3.8U µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2
CR08 0709SF	Fluoranthene	12 µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2
CR08 0709SF	Fluorene	3.8U µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2
CR08 0709SF	Indeno(1,2,3-cd)pyrene	3.8U µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2
CR08 0709SF	2-Methylnaphthalene	17 µg/kg	3.8 µg/kg	8, p. 120; 16, p. 3; 64, p. 2
CR08 0709SF	Naphthalene	11 µg/kg	3.8 µg/kg	8, p. 121; 16, p. 3; 64, p. 2
CR08 0709SF	Phenanthrene	11 µg/kg	3.8 µg/kg	8, p. 122; 16, p. 3; 64, p. 2
CR08 0709SF	Pyrene	11 µg/kg	3.8 µg/kg	8, p. 122; 16, p. 3; 64, p. 2
CR08 0709SF	1,2,3,4,6,7,8-HpCDD	52 ng/kg	4.3 ng/kg	8, p. 66; 16, p. 3; 65, p. 1
CR08 0709SF	1,2,3,4,6,7,8-HpCDF	6.6 ng/kg	4.3 ng/kg	8, p. 66; 16, p. 3; 65, p. 1
CR08 0709SF	1,2,3,4,7,8-HxCDD	0.57J (5.7) ng/kg	4.3 ng/kg	8, p. 66; 16, p. 3; 17, pp.8, 9; 18, pp. i, 1; 65, p. 1
CR08 0709SF	1,2,3,6,7,8-HxCDD	1.4J (14) ng/kg	4.3 ng/kg	8, p. 66; 16, p. 3; 17, pp. 8, 9; 18, pp. i, 1; 65, p. 1
CR08 0709SF	1,2,3,7,8,9-HxCDD	1.4J (14) ng/kg	4.3 ng/kg	8, p. 66; 16, p. 3; 17, pp. 8, 9; 18, pp. i, 1; 65, p. 1
CR08 0709SF	Cadmium	0.52J (0.73) mg/kg	0.57 mg/kg	8, p. 304; 16, p. 3; 17, p. 8, 18; 18, pp. i, 1; 66, p. 1
CR08 0709SF	Chromium	15 mg/kg	1.1 mg/kg	8, p. 304; 16, p. 3; 66, p. 1
CR08 0709SF	Copper	12 mg/kg	2.9 mg/kg	8, p. 304; 16, p. 3; 66, p. 1
CR08 0709SF	Lead	30 mg/kg	1.1 mg/kg	8, p. 304; 16, p. 3; 66, p. 1
CR08 0709SF	Mercury	0.11U mg/kg	0.11 mg/kg	8, p. 304; 16, p. 3; 66, p. 1
CR08 0709SF	Nickel	8.7 mg/kg	4.6 mg/kg	8, p. 304; 16, p. 3; 66, p. 1
CR08 0709SF	Zinc	50 mg/kg	6.9 mg/kg	8, p. 304; 16, p. 3; 66, p. 1
Contaminated Surface Soil Samples				
CR09 0709SF	Benzo(a)anthracene	100 µg/kg	43 µg/kg	8, p. 124; 16, p. 4; 64, p. 2
CR09 0709SF	Benzo(a)pyrene	110 µg/kg	43 µg/kg	8, p. 124; 16, p. 4; 64, p. 2
CR09 0709SF	Benzo(k)fluoranthene	110 µg/kg	43 µg/kg	8, p. 124; 16, p. 4; 64, p. 2
CR09 0709SF	Carbazole	37 µg/kg	4.3 µg/kg	8, p. 124; 16, p. 4; 64, p. 2
CR09 0709SF	Chrysene	140 µg/kg	43 µg/kg	8, p. 124; 16, p. 4; 64, p. 2

TABLE 3: Analytical Results for Source No. 1 Samples –2009				
Sample ID	**Hazardous Substance**	**Hazardous Substance Concentration**	**MRL**	**References**
CR09 0709SF	Dibenzo(a,h)anthracene	26J (26) µg/kg	4.3 µg/kg	8, p. 124; 16, p. 4; 17, pp. 8, 14; 18, pp. i, 1; 64, p. 2
CR09 0709SF	Fluoranthene	140 µg/kg	43 µg/kg	8, p. 124; 16, p. 4; 64, p. 2
CR09 0709SF	Fluorene	5.2 µg/kg	4.3 µg/kg	8, p. 124; 16, p. 4; 64, p. 2
CR09 0709SF	Indeno(1,2,3-cd)pyrene	83 µg/kg	4.3 µg/kg	8, p. 124; 16, p. 4; 64, p. 2
CR09 0709SF	2-Methylnaphthalene	110 µg/kg	43 µg/kg	8, p. 123; 16, p. 4; 64, p. 2
CR09 0709SF	Naphthalene	84 µg/kg	43 µg/kg	8, p. 124; 16, p. 4; 64, p. 2
CR09 0709SF	Phenanthrene	94 µg/kg	43 µg/kg	8, p. 125; 16, p. 4; 64, p. 2
CR09 0709SF	Pyrene	150 µg/kg	43 µg/kg	8, p. 125; 16, p. 4; 64, p. 2
CR09 0709SF	1,2,3,4,6,7,8-HpCDD	710 ng/kg	3.9 ng/kg	8, p. 67; 16, p. 4; 65, p. 1
CR09 0709SF	1,2,3,4,6,7,8-HpCDF	150 ng/kg	3.9 ng/kg	8, p. 67; 16, p. 4; 65, p. 1
CR09 0709SF	Copper	45 mg/kg	3.2 mg/kg	8, p. 306; 16, p. 4; 66, p. 2
CR09 0709SF	Lead	290 mg/kg	1.3 mg/kg	8, p. 306; 16, p. 4; 66, p. 2
CR09 0709SF	Mercury	0.37 mg/kg	0.14 mg/kg	8, p. 306; 16, p. 4; 66, p. 2
CR09 0709SF	Zinc	760 mg/kg	7.7 mg/kg	8, p. 306; 16, p. 4; 66, p. 2
CR13 0709SF	Anthracene	290J (290) µg/kg	25 µg/kg	8, p. 135; 16, p. 3; 17, pp. 8, 14; 18, pp. i, 2; 64, p. 3
CR13 0709SF	Benzo(a)anthracene	530 µg/kg	250 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	Benzo(a)pyrene	560 µg/kg	250 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	Benzo(k)fluoranthene	780 µg/kg	250 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	Carbazole	68 µg/kg	25 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	Chrysene	800 µg/kg	250 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	Dibenzo(a,h)anthracene	98 µg/kg	25 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	Fluoranthene	730 µg/kg	250 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	Fluorene	25 µg/kg	25 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	Indeno(1,2,3-cd)pyrene	330 µg/kg	25 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	2-Methylnaphthalene	520 µg/kg	250 µg/kg	8, p. 135; 16, p. 3; 64, p. 3
CR13 0709SF	Naphthalene	270 µg/kg	25 µg/kg	8, p. 136; 16, p. 3; 64, p. 3
CR13 0709SF	Phenanthrene	210 µg/kg	25 µg/kg	8, p. 137; 16, p. 3; 64, p. 3
CR13 0709SF	Pyrene	780 µg/kg	250 µg/kg	8, p. 137; 16, p. 3; 64, p. 3
CR13 0709SF	1,2,3,4,6,7,8-HpCDD	1,000 ng/kg	4.7 ng/kg	8, p. 72; 16, p. 3; 65, p. 2
CR13 0709SF	1,2,3,4,6,7,8-HpCDF	180 ng/kg	4.7 ng/kg	8, p. 72; 16, p. 3; 65, p. 2
CR13 0709SF	Copper	57 mg/kg	4.6 mg/kg	8, p. 316; 16, p. 3; 66, p. 2

TABLE 3: Analytical Results for Source No. 1 Samples –2009				
Sample ID	**Hazardous Substance**	**Hazardous Substance Concentration**	**MRL**	**References**
CR13 0709SF	Zinc	160 mg/kg	11 mg/kg	8, p. 316; 16, p. 3; 66, p. 2

Notes:

( )	Although not required by the HRS for source data, concentration shown in parentheses was adjusted based on bias in accordance with References 17, p. 8, and 18, pp. i, 1, 2, to show the relative increase over the background level.
CR	Clinch River
ID	Identification
HpCDD	Heptachlorodibenzodioxin
HpCDF	Heptachlorodibenzofuran
HxCDD	Hexachlorodibenzodioxin
J	The identification of the analyte is acceptable; the reported value is an estimate (Ref. 8, pp. 53, 98, 277)
MRL	Minimum reporting limit
µg/kg	Micrograms per kilogram
mg/kg	Milligrams per kilogram
ng/kg	Nanograms per kilogram
SF	Surface soil
SFD	Surface soil duplicate
U	The analyte was not detected at or above the reporting limit (Ref. 8, pp. 98, 277)

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

Source No. 1 is an area of contaminated soil resulting from discrete operations (e.g., disposal practices) around the process area (Refs. 8, pp. 9, 14 through 21, 29, 30; 10, pp. 6, 47; 11, pp. 21, 38 through 42, 47, 48, 49; see Figure 3 of this HRS documentation record). Source No. 1 samples contain anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(k)fluoranthene; carbazole; chrysene; dibenzo(a,h)anthracene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; 2-methlynaphthalene; naphthalene; phenanthrene; pyrene; 1,2,3,4,6,7,8-HpCDD; 1,2,3,4,6,7,8-HpCDF; 1,2,3,4,7,8-HxCDD; 1,2,3,6,7,8-HxCDD; 1,2,3,7,8,9-HxCDD; cadmium; chromium; copper; lead; manganese; mercury; nickel; silver; and zinc (see Tables 2 and 3 of this HRS documentation record).

During the 2009 TDEC site reassessment, no examined portion of the CRC property, including Source 1, contained a functioning and maintained run-on control or runoff management system (Ref. 39). Therefore, a containment factor value of 10, as noted below in Table 4, was assigned for the surface water migration pathway (Ref. 1, Section 4.1.2.1.2.1.1, and Table 4-2).

Analytical results for sediment samples collected from the Emory River, which receives runoff from Source No. 1, indicate that a release of hazardous substances has occurred to the surface water migration pathway, as documented in Section 4.0 of this HRS documentation record.

TABLE 4: Containment Factors for Source No. 1

Containment Description	Containment Factor Value	References
Gas release to air	NS	NA
Particulate release to air	NS	NA
Release to ground water	NS	NA
Release via overland migration or flood: no engineered maintained cover or functioning and maintained run-on control system or runoff management system is present.	10	1, Section 4.1.2.1.2.1.1; 8, pp. 1, 2, 30, 33, 34, 35; 10, pp. 6, 33, 39, 40; 14, pp. 164 through 174, 186, 187; 39

Notes:

NA Not applicable
NS Not scored

2.4.2.1 HAZARDOUS WASTE QUANTITY

2.4.2.1.1 Hazardous Constituent Quantity

The mass of CERCLA hazardous substances contained in Source No. 1 is not known. The information available is not sufficient to evaluate Tier A, hazardous constituent quantity, as required by Reference 1, Section 2.4.2.1.1.

Hazardous Constituent Quantity Assigned Value: NS

2.4.2.1.2 Hazardous Wastestream Quantity

The mass of CERCLA hazardous substances, pollutants, and contaminants contained in Source No. 1 cannot be adequately quantified or verified. The information available is not sufficient to evaluate Tier B, hazardous wastestream quantity, as required by Reference 1, Section 2.4.2.1.2.

Hazardous Wastestream Quantity Assigned Value: NS

2.4.2.1.3 Volume

The depth of the contaminated soil source is not known and the extent of the source has not been determined. The information available is not sufficient to evaluate Tier C, volume, as required by Reference 1, Table 2-5.

Volume Assigned Value: 0

2.4.2.1.4 Area

Source No. 1 contains multiple discrete areas of contaminated soil where facility operations and/or disposal occurred; however, the extent and continuity of contamination between discrete areas in Source No. 1 is not known (Refs. 8, pp. 15, 18, 20, 21, 30; 11, pp. 21, 38 through 42, 47 through 49; see Figure 3 of this HRS documentation record). Therefore, the area of Source No. 1 is undetermined, but greater than zero.

Sum (square feet [ft^2]): >0
Equation for Assigning Value (Ref. 1, Table 2-5): Area (A)/34,000

Area Assigned Value: >0

2.4.2.1.5 Source Hazardous Waste Quantity Value

Source No. 1 is assigned a source HWQ value that is undetermined, but greater than zero (Ref. 1, Section 2.4.2.1.5).

Source HWQ Value: >0

SUMMARY OF SOURCE DESCRIPTIONS

TABLE 5: Summary of Source Descriptions

Source No.	Source Hazardous Waste Quantity Value	Source Hazardous Constituent Quantity Complete? (Yes/No)	Containment Factor Value by Pathway			
			Ground Water (Ref. 1, Table 3-2)	Surface Water Overland/ Flood (Ref. 1, Table 4-2)	Air	
					Gas (Ref. 1, Table 6-3)	Particulate (Ref. 1, Table 6-9)
1	>0	No	NS	10	NS	NS

Notes:

NS Not scored
Also see Table 4 and Section 2.4.2.1.5 of this HRS documentation record.

Sum of Source Hazard Waste Quantity Values: >0

Other Possible Sources

Black Liquor Pond: Wastes from paper mill operations were dumped on the CRC property into an unlined surface impoundment (black liquor pond), located on the southern portion of the property (Refs. 8, p. 29; 10, p. 6; 14, p. 155). The CRC property flooded in the fall of 1990 and washed black liquor and coal tar waste water into the Emory River (Ref. 14, p. 8). From May 1990 to March 1991, TDHE collected surface water samples from the surface impoundment (black liquor pond). The samples contained arsenic, acetone, toluene, and xylenes (Refs. 8, p. 29; 14, pp. 13, 16, 63, 64, 113, 114). In 2011, TDEC observed liquid in the pond; however, it is not known if this liquid is black liquor (Ref. 45, p. 1).

Former Coal Tar Pond: Wastes from paper mill operations were also dumped on the CRC property into an unlined surface impoundment (former coal tar pond), located on the northwestern side of the property (Refs. 10, p. 6; 11, pp. 7, 11). The CRC property flooded in the fall of 1990 and washed black liquor and coal tar waste water into the Emory River (Ref. 14, p. 8). From May 1990 to March 1991, TDHE collected surface water samples from the surface impoundment (former coal tar pond). The samples contained arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, zinc, acetone and phenols (Refs. 14, pp. 14, 16, 63, 64, 113, 114). In the late 1990s, the property owner (owner's name unknown) paved the northern portion of the CRC property, including the coal tar pond (Refs. 10, p. 6; 39; 45, p. 1). In 2012, during the EPA removal action, a soil boring was advanced through the concrete at the former location of the coal tar pond to a depth of 35 feet bgs. Black liquor was observed in the boring (Ref. 45, pp. 1, 19, 21).

Waste Paper Piles: Wastes from paper mill operations were dumped on the CRC property in multiple waste paper piles, including: (1) waste paper pile 1, located about 525 feet north of the former paper and pulp mill building; (2) waste paper pile 2, located adjacent to the black liquor pond; (3) waste paper pile 3, located about 100 feet northwest of the former paper and pulp mill building, and (4) waste paper pile 4, located on a concrete slab inside a fenced enclosure on the southern portion of Parcel 002.00 (Refs. 8, p. 29; 10, p. 6; 14, pp. 169 through 183, 185). From May 1990 to March 1991, TDHE collected surface soil samples from waste paper pile 1 and waste paper pile 2. The samples contained arsenic, cadmium, chromium, copper, lead, manganese, nickel, silver, zinc, aldrin, acetone, benzene, methylene chloride, MEK, and xylenes (Ref. 14, pp. 16, 63, 64, 80, 81, 113, 114).

Residual Releases from Tanks and Containers: In 2005, Shaw observed about 106 damaged, leaking, or open containers (55-gallon drums and two 250-gallon totes) containing various oily liquid wastes in and

around the chipper shed. The oily liquid wastes were suspected to contain lubricant oils, white paper and black paper liquor waste, water, and other waste. Notable dark staining was observed in the area near the leaking containers (Ref. 10, pp. 39, 51, 52). In 2009, TDEC personnel observed the same drums observed by Shaw in 2005 as well as several large tanks, including a 600,000-gallon AST, on the CRC property (Ref. 8, pp. 1, 3, 29, 37). In September 2011, a waste sample was collected of the liquid within a 15,000-gallon AST located southeast of the former paper and pulp mill building. This sample contained PAHs, specifically benzo(a)pyrene, which exceeded its National Recommended Water Quality Criteria value (Refs. 59, pp. 3, 5, 6, 11; 61, p. 1). In February 2012, EPA removed all drums and containers from the CRC property and excavated a UST, which contained approximately 38,500 gallons of black liquor that was located southeast of the former paper and pulp mill building. Once the UST was removed, black liquor and associated sludge were observed in the tank pit. This material was removed; however, about 6 inches of water containing black liquor was noted seeping into the excavated tank pit (Refs. 45, pp. 19, 21, 22, 24, 26).

Mill By-product: During the 2005 TBA Phase II investigation, two samples were collected from the interior of the paper and pulp mill building (Ref. 11, p. 16). One composite sample (SS-CRCB-A5-21-00-01) was collected from material located on the floor of the paper and pulp mill building, and one composite sample (SS-CRCB-A5-22-00-01) was collected from a sump (Ref. 11, pp. 16, 21, 83 through 86). These samples contained arsenic, beryllium, cadmium, chromium, copper, lead, manganese, nickel, selenium, and zinc (Ref. 11, pp. 26, 27, 50).

In 2009, TDEC observed a by-product from facility operations, which appeared to be a dry, powdery, dark brown to gray, extremely fine-grained material that was approximately 3 inches thick, overlying the concrete floor of the paper and pulp mill building (Ref. 39). This same by-product was observed within 1 to 2 feet outside the paper and pulp mill building along the eastern side of the building, adjacent to the Emory River (Ref. 45, p. 1). A composite sample (CR10 0709SF) was collected and contained PAHs; dioxins and furans; PCBs; and metals including anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(k)fluoranthene; carbazole; chrysene; dibenzo(a,h)anthracene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; 2-methlynaphthalene; naphthalene; phenanthrene; pyrene; 1,2,3,4,6,7,8-HpCDD; 1,2,3,4,6,7,8-HpCDF; 1,2,3,6,7,8-HxCDD; PCB-1242; PCB-1254; cadmium; chromium; copper; lead; mercury; nickel; and zinc (Refs. 8, pp. 9, 68, 87, 126, 127, 128, 308; 39). The paper and pulp mill building was demolished in 2010 (Ref. 45, p. 1). The demolition debris was not removed from the property but was pushed into vats inside the former paper and pulp mill building (Ref. 45, pp. 1, 4, 6, 7, 10). By-product on the floor inside the building was not removed before demolition (Ref. 45, p. 1). By-product is still present on the ground surface at the location of the former paper and pulp mill building and in surrounding areas (Refs. 8, pp. 36, 39; 45, p. 1). No functioning and maintained run-on control or runoff management system was observed in the vicinity of the former paper and pulp mill building during the 2009 TDEC site reassessment (Refs. 39; 45, p. 1).

4.0 SURFACE WATER MIGRATION PATHWAY

4.1 OVERLAND/FLOOD MIGRATION COMPONENT – Emory/Clinch Rivers

4.1.1.1 Definition of Hazardous Substance Migration Path for Overland/Flood Component

The hazardous substance migration pathway includes both the overland segment and the in-water segment that hazardous substances would take as they migrate away from sources. The overland segment begins at the source and proceeds downgradient to the probable point of entry (PPE) to surface water. The in-water segment at the PPE continues in the direction of flow (Ref. 1, Section 4.1.1.1).

Surface water runoff from Source No. 1 follows land topography, which slopes east and south, and enters the Emory River along the CRC property's eastern boundary between the two observed release samples (CR03 0709SD and CR06 0709SD); this area generally corresponds to the area of the property described as the "drainage" area (Refs. 8, p. 6; 11, pp. 11, 17, 88; see Figure 3 of this HRS documentation record). From the southern corner of Source No. 1 (SS-CRCB-A4-27-00-01), surface water runoff flows about 230 feet southeast to the western bank of the Emory River. From the central portion of Source No. 1 (CR09 0709SF), surface water runoff flows about 270 feet southeast to the western bank of the Emory River. From the northern corner of Source No. 1 (CR13 0709SF), surface water runoff flows about 90 feet east to the western bank of the Emory River (see Figures 1 and 3 of this HRS documentation record). The PPE extends about 250 feet along Emory River between the two observed release samples (CR03 0709SD and CR06 0709SD) (see Figures 1 and 3 of this HRS documentation record). Samples CR06 0709SD/CR06 0709SDD and CR03 0709SD were each collected at the confluence of drainage ditches originating on the Clinch River Corporation property and the Emory River, and are located within the PPE (Ref. 8, p. 7; 67, p. 1).

The surface water migration pathway target distance limit (TDL) begins at sample location CR03 0709SD, which is the downstream boundary of the PPE. From this portion of the PPE, flow continues in a northerly, then southeasterly direction for about 11 miles and empties into the Clinch River. Flow continues in the Clinch River for about 4 miles, where the 15-mile surface water migration pathway TDL is completed (Refs. 3; 19; 21; see Figure 3 of this HRS documentation record). The Emory River and the Clinch River are part of the Watts Bar Reservoir, which was constructed in 1942 (Refs. 34, p. 1; 48, p. i). The flow rate for the Emory River at Oakdale, Tennessee, located about 6.9 miles upstream of the CRC property, is 1,469 cubic feet per second (cfs) (Refs. 22, pp. 1, 3; 35). The CRC property is located within the 100-year floodplain of the Emory River (Refs. 23; 24, p. 1).

4.1.2.1.1 OBSERVED RELEASE

Direct Observation

Evidence of observed release by direct observation includes:

- Several spills, releases, and NPDES permit violations have been documented throughout the facility's operational history. Between 1988 and 1989, the facility illegally discharged process water, cooling water, and waste paper wash runoff into the Emory River (Ref. 14, pp. 345, 354, 357, 359, 361, 367). Discoloration (black and gray) of the Emory River directly adjacent to and downstream of the CRC property was also documented during this period (Ref. 14, pp. 354, 360, 362).
- The CRC property flooded in 1990, and as a result, waste paper, black liquor, and coal tar wastewater were deposited into the Emory River (Ref. 14, pp. 8, 159 through 161, 164 through 166, 186, 187).
- During the 1991 TDHE site inspection, TDHE observed (1) black liquor and coal tar leaching into the Emory River from the CRC property below the water line, and (2) that the south waste paper impoundment had partially collapsed into the Emory River, dumping waste paper and waste paper rolls into the river (Ref. 14, pp. 8, 14, 16, 165 through 168, 186, 187).
- In June 2002, the owner of Parcel 003.01 was convicted of intentionally releasing approximately 500,000 gallons of process liquid containing black liquor and solids, the contents of an AST, onto the ground and into the Emory River on February 14, 1999, during a period of heavy rains (Refs. 7, p. 11; 46, p. 1; 47, p. 11; 62, p. 17).

Paper and pulp mill effluent can contain PAHs; dioxins and furans; and metals (Refs. 49, p. 7; 51, p. 10; 54, pp. 1-1, 3-7, 3-8, 3-11). PAHs are contained in coal tar (Refs. 9, p. 220; 14, p. 8; 30, pp. 9, 21). Dioxins and furans accumulate in the pulp and are chemicals of concern in wastewater treatment sludge and in liquid (re-pulped) effluent (Ref. 50, pp. 6, 10). Metals, such as cadmium, chromium, copper, lead, mercury, nickel, and zinc can be contained in effluent and in pulp mill sludge (Refs. 50, p. 10; 51, pp. 1, 2, 3; 54, pp. 1-1, 3-11).

Chemical Analysis

Background Sample

The background sediment sample listed in Table 6 (CR02 0709SD) was collected during the 2009 TDEC site reassessment (Ref. 8, pp. 3, 7). Background sediment sample CR02 0709SD was collected from the Emory River adjacent to the CRC property at a depth of 0 to 4 inches below the surface water-sediment interface (bsw), upstream and outside the influence of Source No. 1 (Refs. 8, pp. 7, 30, 32, 358; 39; see Figure 3 of this HRS documentation record). The sample was collected using a ponar dredge device (Refs. 8, p. 358; 39).

Background and observed release sediment samples were collected during the same sampling event, at the same depths, from similar soil types (silty sand with gravel and organics), and in accordance with the same sampling procedures (Refs. 8, p. 358; 16, p. 6; 39; 57, p. 1; see Figure 3 of this HRS documentation record).

The background sediment sample was collected in accordance with the EPA approved TDEC SAP and QAPP, specifically the EPA Region 4 SESD FBQSTP for Soil Sampling, SESDPROC-300-R1 (Refs. 8, pp. 327, 346, 359; 39). Logbook notes are provided in Reference 16. The chain-of-custody records are provided in References 64 and 66. The location of the sediment sample presented in Table 6 is depicted in Reference 8, page 30 (see Figure 3 of this HRS documentation record).

TABLE 6: Background Sediment Sample – 2009					
Sample ID	**Sample Location**	**Distance from PPE**	**Depth (inches bsw)**	**Date Sampled**	**References**
CR02 0709SD	Along the western bank of the Emory River, and south of Source No. 1	600 feet upstream of PPE	0 to 4	07/21/2009	3; 8, pp. 6, 7, 30; 16, p. 7; 39; see Figure 3 of this HRS documentation record

Notes:

bsw	Below the surface water-sediment interface
CR	Clinch River
ID	Identification
PPE	Probable point of entry
SD	Sediment

Background Concentrations

The background sediment sample listed in Table 7 was collected during the 2009 TDEC site reassessment (Ref. 8, pp. 3, 7). The background sediment sample was analyzed for SVOCs and metals (Ref. 8, p. 3). SVOC analysis (EPA Methods 8270D and 8270SIM) was conducted by the EPA Region 4 SESD ASB in accordance with the ASB LOQAM (Ref. 8, pp. 3, 95). EPA Region 4 SESD verified SVOC data in accordance with the ASB LOQAM, EPA methods and guidelines (Refs. 8, pp. 95, 98). Total metals were analyzed by CompuChem, currently known as Liberty, in accordance with EPA CLP SOW ILM05.3 (Ref. 8, pp. 272, 273, 284). EPA Region 4 SESD reviewed the total metals data in accordance with the CLP SOW and EPA guidelines (Refs. 8, pp. 3, 273).

The MRLs are listed on the analytical data sheets in Reference 8, Appendix 1. Each MRL is sample-specific and analyte-specific and corresponds to the lowest quantitative point on the calibration curve; it is adjusted for the amount of sample prepared and any dilutions performed, as well as for percent moisture (Ref. 15). The MRLs are equivalent to SQLs as defined in HRS Section 1.1, Definitions (Refs. 1, Section 1.1; 8, pp. 53, 98; 15). The analytical data sheets are provided in Reference 8, Appendix 1.

TABLE 7: Analytical Results for Background Sediment Sample – 2009

Sample ID	Hazardous Substance	Hazardous Substance Concentration	MRL	References
CR02 0709SD	Benzo(a)anthracene	5.9 µg/kg	4.2 µg/kg	8, p. 100; 64, p. 1
CR02 0709SD	Benzo(k)fluoranthene	4.2U µg/kg	4.2 µg/kg	8, p. 100; 64, p. 1
CR02 0709SD	Carbazole	4.2U µg/kg	4.2 µg/kg	8, p. 100; 64, p. 1
CR02 0709SD	Chrysene	9.7 µg/kg	4.2 µg/kg	8, p. 100; 64, p. 1
CR02 0709SD	Dibenzo(a,h)anthracene	4.2U µg/kg	4.2 µg/kg	8, p. 100; 64, p. 1
CR02 0709SD	Fluoranthene	16 µg/kg	4.2 µg/kg	8, p. 100; 64, p. 1
CR02 0709SD	Fluorene	5.1 µg/kg	4.2 µg/kg	8, p. 100; 64, p. 1
CR02 0709SD	Indeno (1,2,3-cd)pyrene	4.2U µg/kg	4.2 µg/kg	8, p. 100; 64, p. 1
CR02 0709SD	2-Methylnaphthalene	56 µg/kg	4.2 µg/kg	8, p. 99; 64, p. 1
CR02 0709SD	Naphthalene	27 µg/kg	4.2 µg/kg	8, p. 100; 64, p. 1
CR02 0709SD	Phenanthrene	28 µg/kg	4.2 µg/kg	8, p. 101; 64, p. 1
CR02 0709SD	Pyrene	12 µg/kg	4.2 µg/kg	8, p. 101; 64, p. 1
CR02 0709SD	Chromium	4.4 mg/kg	1.3 mg/kg	8, p. 284; 66, p. 1
CR02 0709SD	Copper	3.5 mg/kg	3.3 mg/kg	8, p. 284; 66, p. 1
CR02 0709SD	Manganese	54 mg/kg	2.0 mg/kg	8, p. 284; 66, p. 1

Notes:

CR	Clinch River
ID	Identification
µg/kg	Micrograms per kilogram
mg/kg	Milligrams per kilogram
MRL	Minimum reporting limit
SD	Sediment

Contaminated Samples

Sediment samples listed in Table 8 were collected during the 2009 TDEC site reassessment (Ref. 8, pp. 3, 7). The samples were collected at a depth of 0 to 4 inches bsw along the western bank of the Emory River (Refs. 8, pp. 7, 30, 358; 39; see Figure 4 of this HRS documentation record).

The samples were collected in accordance with the EPA Region 4 SESD FBQSTP for Sediment Sampling, SESDPROC-200-R1 (Ref. 8, p. 358; 39). Logbook notes are provided in Reference 16. The chain-of-custody records are provided in References 64 and 66. The locations of the sediment samples presented in Table 8 are depicted in Reference 8, page 30 (see Figure 4 of this HRS documentation record).

TABLE 8: Contaminated Sediment Samples – 2009

Sample ID	Sample Location	Distance from PPE	Depth (inches bsw)	Date Sampled	References
CR06 0709SD	Along the western bank of the Emory River, east of the former paper and pulp mill building	0 feet from the PPE	0 to 4	07/21/2009	3; 8, pp. 29, 30; 16, p. 8; 39; see Figure 3 of this HRS documentation record
CR06 0709SDD	Along the western bank of the Emory River, east of the former paper and pulp mill building	0 feet from the PPE	0 to 4	07/21/2009	3; 8, pp. 29, 30; 16, p. 8; 39; see Figure 3 of this HRS documentation record
CR03 0709SD	Along the western bank of the Emory River, northeast of the former paper and pulp mill building, about 250 feet downstream from CR06 0709SD and CR06 0709SDD	0 feet from the PPE	0 to 4	07/20/2009	3; 8, pp. 29, 30; 16, p. 6; 39; see Figure 3 of this HRS documentation record

Notes:

bsw	Below the surface water-sediment interface
CR	Clinch River
ID	Identification
PPE	Probable point of entry
SD	Sediment
SDD	Sediment duplicate

Contaminated Concentrations

The sediment samples listed in Table 9 were collected during the 2009 TDEC site reassessment (Ref. 8, pp. 3, 7). The sediment samples were analyzed for SVOCs and total metals (Ref. 8, p. 3). SVOC analysis (EPA Methods 8270D and 8270SIM) was conducted by the EPA Region 4 SESD ASB in accordance with the ASB LOQAM (Ref. 8, pp. 3, 95). EPA Region 4 SESD verified SVOC data in accordance with the ASB LOQAM, EPA methods and guidelines (Refs. 8, pp. 95, 98). Total metals were analyzed by CompuChem, currently known as Liberty, in accordance with EPA CLP SOW ILM05.3 (Ref. 8, pp. 3, 272, 273, 290, 298, 300). EPA Region 4 SESD reviewed the total metals data in accordance with the CLP SOW and EPA guidelines (Refs. 8, pp. 3, 273).

The MRLs are listed on the analytical data sheets in Reference 8, Appendix 1. Each MRL is sample-specific and analyte-specific and corresponds to the lowest quantitative point on the calibration curve; it is adjusted for the amount of sample prepared and any dilutions performed, as well as for percent moisture (Ref. 15). The MRLs are equivalent to SQL as defined in HRS Section 1.1, Definitions (Ref. 15). The analytical data sheets are provided in Reference 8, Appendix 1 (Refs. 1, Section 1.1; 8, pp. 53, 98).

TABLE 9: Analytical Results for Contaminated Sediment Samples – 2009

Sample ID	Hazardous Substance	Hazardous Substance Concentration	MRL	References
CR03 0709SD	Benzo(a)anthracene	38 µg/kg	4.3 µg/kg	8, p. 109; 64, p. 1
CR03 0709SD	Benzo(k)fluoranthene	10 µg/kg	4.3 µg/kg	8, p. 109; 64, p. 1
CR03 0709SD	Carbazole	35 µg/kg	4.3 µg/kg	8, p. 109; 64, p. 1
CR03 0709SD	Chrysene	110 µg/kg	43 µg/kg	8, p. 109; 64, p. 1
CR03 0709SD	Dibenzo(a,h)anthracene	5.7 µg/kg	4.3 µg/kg	8, p. 109; 64, p. 1
CR03 0709SD	Fluoranthene	120 µg/kg	43 µg/kg	8, p. 109; 64, p. 1
CR03 0709SD	Fluorene	40 µg/kg	4.3 µg/kg	8, p. 109; 64, p. 1
CR03 0709SD	2-Methylnaphthalene	1,600 µg/kg	43 µg/kg	8, p. 108; 64, p. 1
CR03 0709SD	Naphthalene	1,100 µg/kg	43 µg/kg	8, p. 109; 64, p. 1
CR03 0709SD	Phenanthrene	690 µg/kg	43 µg/kg	8, p. 110; 64, p. 1
CR03 0709SD	Pyrene	110 µg/kg	43 µg/kg	8, p. 110; 64, p. 1
CR03 0709SD	Chromium	18 mg/kg	1.4 mg/kg	8, p. 290; 66, p. 1
CR03 0709SD	Copper	14 mg/kg	3.4 mg/kg	8, p. 290; 66, p. 1
CR03 0709SD	Manganese	200 mg/kg	2.0 mg/kg	8, p. 290; 66, p. 1
CR06 0709SD	Benzo(a)anthracene	38 µg/kg	4.4 µg/kg	8, p. 148; 64, p. 4
CR06 0709SD	Benzo(k)fluoranthene	15 µg/kg	4.4 µg/kg	8, p. 148; 64, p. 4
CR06 0709SD	Carbazole	31 µg/kg	4.4 µg/kg	8, p. 148; 64, p. 4
CR06 0709SD	Chrysene	110 µg/kg	44 µg/kg	8, p. 148; 64, p. 4
CR06 0709SD	Dibenzo(a,h)anthracene	5.7 µg/kg	4.4 µg/kg	8, p. 148; 64, p. 4

TABLE 9: Analytical Results for Contaminated Sediment Samples – 2009				
Sample ID	**Hazardous Substance**	**Hazardous Substance Concentration**	**MRL**	**References**
CR06 0709SD	Fluoranthene	130 µg/kg	44 µg/kg	8, p. 148; 64, p. 4
CR06 0709SD	Fluorene	37 µg/kg	4.4 µg/kg	8, p. 148; 64, p. 4
CR06 0709SD	Indeno(1,2,3-cd)pyrene	14 µg/kg	4.4 µg/kg	8, p. 148; 64, p. 4
CR06 0709SD	2-Methylnaphthalene	1,400 µg/kg	44 µg/kg	8, p. 147; 64, p. 4
CR06 0709SD	Naphthalene	980 µg/kg	44 µg/kg	8, p. 148; 64, p. 4
CR06 0709SD	Phenanthrene	590 µg/kg	44 µg/kg	8, p. 149; 64, p. 4
CR06 0709SD	Pyrene	110 µg/kg	44 µg/kg	8, p. 149; 64, p. 4
CR06 0709SD	Manganese	210 mg/kg	2.0 mg/kg	8, p. 298; 66, p. 3
CR06 0709SDD	Benzo(a)anthracene	39 µg/kg	4.3 µg/kg	8, p. 151; 64, p. 5
CR06 0709SDD	Benzo(k)fluoranthene	8.6 µg/kg	4.3 µg/kg	8, p. 151; 64, p. 5
CR06 0709SDD	Carbazole	33 µg/kg	4.3 µg/kg	8, p. 151; 64, p. 5
CR06 0709SDD	Chrysene	120 µg/kg	43 µg/kg	8, p. 151; 64, p. 5
CR06 0709SDD	Dibenzo(a,h)anthracene	6.0 µg/kg	4.3 µg/kg	8, p. 151; 64, p. 5
CR06 0709SDD	Fluoranthene	110 µg/kg	43 µg/kg	8, p. 151; 64, p. 5
CR06 0709SDD	Fluorene	43 µg/kg	4.3 µg/kg	8, p. 151; 64, p. 5
CR06 0709SDD	Indeno(1,2,3-cd)pyrene	9.5 µg/kg	4.3 µg/kg	8, p. 151; 64, p. 5
CR06 0709SDD	2-Methylnaphthalene	1,700 µg/kg	43 µg/kg	8, p. 150; 64, p. 5
CR06 0709SDD	Naphthalene	1,100 µg/kg	43 µg/kg	8, p. 151; 64, p. 5
CR06 0709SDD	Phenanthrene	720 µg/kg	43 µg/kg	8, p. 152; 64, p. 5
CR06 0709SDD	Pyrene	110 µg/kg	43 µg/kg	8, p. 152; 64, p. 5
CR06 0709SDD	Manganese	250 mg/kg	2.0 mg/kg	8, p. 300; 66, p. 3

Notes:

CR	Clinch River
ID	Identification
MRL	Minimum reporting limit
mg/kg	Milligrams per kilogram
µg/kg	Micrograms per kilogram
SD	Sediment
SDD	Sediment duplicate

Attribution

From 1929 to 2002, a paper and pulp mill operated on the CRC property (Refs. 8, p. 2; 10, pp. 4, 5; 14, pp. 22, 315). Former operations included manufacturing corrugated containers using paperboard from pulp production (Ref. 14, pp. 256, 280, 315). The manufacturing process included partially digesting raw hardwood chips with sodium sulfite, sodium carbonate, and live steam. The wood chips were further refined using a mechanical pulping process (Refs. 10, p. 6; 14, pp. 8, 211, 280, 400; 44, p. 10).

By-products of the paper manufacturing process included paper waste, black liquor (spent processing waste), and coal tar constituents (Refs. 10, p. 6; 11, p. 6; 14, p. 8). Black liquor can be composed of phenols, sodium hydroxide, sodium oxide, and sulfur; as well as metals, such as calcium and magnesium (Refs. 10, p. 6; 14, p. 8; 29, p. 19). Coal tar consists of PAHs, phenols, heterocyclic oxygen, sulfur, and nitrogen compounds (Refs. 9, p. 220; 14, p. 8; 30, p. 9). Dioxins, furans, PAHs, and metals were also produced as by-products of the paper manufacturing process (Refs. 49, p. 7; 51, p. 10; 54, pp. 1-1, 3-3, 3-4, 3-7, 3-8, 3-10, 3-11; 55, pp. 1, 2).

Waste paper, black liquor, and coal tar wastes were disposed of on the CRC property (Refs. 10, p. 6; 11, p. 7; 14, pp. 8, 155, 156, 157, 169 through 183, 185). The black liquor and coal tar wastes were placed in two unlined surface impoundments (the black liquor pond and the former coal tar pond) and in drums (Refs. 10, p. 31; 11, pp. 7, 11; 14, pp. 8, 155). Waste paper was placed in piles located in various places around the process area (Refs. 10, p. 6; 14, pp. 169 through 181, 185).

Paper and pulp mill effluent can contain PAHs; dioxins and furans; and metals (Refs. 49, p. 7; 51, p. 10; 54, pp. 1-1, 3-3, 3-4, 3-7, 3-8, 3-10, 3-11; 55, pp. 1, 2). PAHs, such as fluoranthene, fluorene, phenanthrene, and pyrene are contained in coal tar (Refs. 49, p. 7; 51, pp. 6, 10). Dioxins and furans accumulate in the pulp and are chemicals of concern in wastewater treatment sludge and in liquid (re-pulped) effluent (Ref. 50, pp. 6, 10). Metals, such as cadmium, chromium, copper, lead, mercury, nickel, and zinc can be contained in effluent and in pulp mill sludge (Refs. 50, p. 10; 51, pp. 1, 2, 3; 54, pp. 1-1, 3-10, 3-11).

Several spills, releases, and NPDES permit violations have been documented throughout the facility's operational history. Between 1988 and 1989, the facility illegally discharged process water, cooling water, and waste paper wash runoff into the Emory River (Ref. 14, pp. 345, 354, 359, 361, 367). Discoloration (black and gray) of the Emory River directly adjacent to and downstream of the CRC property was also documented during this period (Ref. 14, pp. 354, 357, 360, 362). In 2011, pipes and seeps that discharge into the Emory River were observed along the eastern boundary of the CRC property (Ref. 45, pp. 12 through 18). The northern portion of the CRC property (near waste paper pile 1) flooded in 1990, and as a result, waste paper, black liquor, and coal tar waste water were deposited into the Emory River (Ref. 14, pp. 8, 159 through 161, 164 through 166, 186, 187). During the 1991 TDHE site inspection, TDHE observed (1) black liquor and coal tar leaching into the Emory River from the CRC property below the water line, and (2) that the south waste paper impoundment had partially collapsed into the Emory River, dumping waste paper and waste paper rolls into the river (Ref. 14, pp. 8, 14, 16, 165 through 168, 186, 187). In June 2002, the owner of Parcel 003.01 was convicted of intentionally releasing approximately 500,000 gallons of process liquid containing black liquor and solids, the contents of an AST, onto the ground and into the Emory River on February 14, 1999, during a period of heavy rains (Refs. 7, p. 11; 46, p. 1; 47, p. 11; 62, p. 17).

Surface water runoff from Source No. 1 follows land topography, which slopes east and south, and enters the Emory River along the CRC property's eastern boundary between observed release samples CR03 0709SD and CR06 0709SD, which is the PPE for the surface water migration pathway (Refs. 8, p. 6; 11, pp. 11, 17, 88; see Figure 3 of this HRS documentation record).

Surface and subsurface soil samples collected from Source No. 1 (contaminated soil resulting from discrete operations (e.g., disposal practices) around the process area) contained PAHs; dioxin and furans; and metals (Refs. 8, pp. 67, 72, 123, 124, 125, 135, 136, 137, 306, 316; 27, pp. 1171, 1173, 1174, 1189,

1192, 1195, 1196; see also Figure 3 of this HRS documentation record). Specifically, the samples contained benzo(a)pyrene, dibenzo(a,h)anthracene, naphthalene, 1,2,3,4,6,7,8-HpCDD; 1,2,3,4,6,7,8-HpCDF, cadmium, chromium, copper, manganese, and mercury, among others (see Tables 2 and 3 of this HRS documentation record). Analyses of sediment samples collected from the western bank of the Emory River (which abuts the CRC property) within and downstream of the PPE contained dibenzo(a,h)anthracene, naphthalene, chromium, copper, and manganese, among others, at concentrations above background levels (see Tables 8 and 9 of this HRS documentation record). The presence of these hazardous substances in Source No. 1 and in sediment samples collected from the western bank of the Emory River, and the lack of a functioning and maintained run-or control and runoff management system indicate that Source No. 1 is not contained (Refs. 1, Table 4-2; 39).

Current property uses do not suggest another source of contamination to the Emory River in the vicinity of the Clinch River Corporation property (Ref. 57, p. 1). No NPL sites are located within a one-mile radius of the CRC property (Ref. 31, pp. i, 3). Master Wood Products (MWP), also known as the Christmas Lumber Company Truss Shop, is located approximately 0.91 mile upstream of the CRC property and the CRC PPE and background sediment samples (Ref. 31, pp. i, 5, 9, 10, 11). MWP produces non-upholstered wooden household furniture (Ref. 31, p. 4). As of September 2, 2000, MWP was listed as an inactive RCRA facility (Ref. 31, p. 4).

The hazardous substances listed below have been documented in Source No. 1 as well as in sediments of the Emory River, indicating that a release has occurred or is occurring at the CRC property (see Tables 2 and 3 in Section 2.2.2 for Source No. 1, and Table 9 in Section 4.1.2.1.1, Observed Release, of this HRS documentation record).

Hazardous Substances in the Release:

Benzo(a)anthracene
Benzo(k)fluoranthene
Carbazole
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene
Naphthalene
Phenanthrene
Pyrene
Chromium
Copper
Manganese

Surface Water Observed Release Factor Value: 550

4.1.2 DRINKING WATER THREAT WASTE CHARACTERISTICS

No drinking water intakes are located on the Emory River or on the Clinch River within the 15-mile downstream TDL (Refs. 3; 32, pp. i, 4). The City of Harriman provides municipal water to area residents from a surface water intake located on the Emory River about 1.33 miles upstream of the CRC property (Refs. 3; 32, pp. i, 1, 2, 4). The drinking water threat was not scored because it is not expected to contribute significantly to the overall site score.

4.1.3.2 HUMAN FOOD CHAIN THREAT WASTE CHARACTERISTICS

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

Table 10 lists toxicity, persistence, and bioaccumulation factor values for hazardous substances that were detected in the source samples and have containment factor values exceeding 0. The combined toxicity, persistence, and bioaccumulation factor values are assigned in accordance with Reference 1, Section 4.1.3.2.1. Table 9 of this HRS documentation record previously identified those hazardous substances associated with observed release.

TABLE 10: Toxicity/Persistence/Bioaccumulation

Hazardous Substance	Source No.	Observed Release? (Yes/No)	Toxicity Factor Value	Persistence Factor Value[1]	Bioaccumulation Value[2]	Toxicity/ Persistence/ Bioaccumulation Factor Value (Ref. 1, Table 4-16)	Reference
Anthracene	1	No	10	0.4000	50,000	2E+5	2, p. BI-1
Benzo(a)anthracene	1	Yes	1,000	1	50,000	5E+7	2, p. BI-2
Benzo(a)pyrene	1	No	10,000	1	50,000	5E+8	2, p. BI-2
Benzo(k)fluoranthene	1	Yes	100	1	50,000	5E+6	2, p. BI-2
Carbazole	1	Yes	10	0.4000	500	2,000	2, p. BI-2
Chrysene	1	Yes	10	1	5.0	50	2, p. BI-3
Dibenzo(a,h)anthracene	1	Yes	10,000	1	50,000	5E+8	2, p. BI-4
Fluoranthene	1	Yes	100	1	500	5E+4	2, p. BI-2
Fluorene	1	Yes	100	1	500	5E+4	2, p. BI-6
Indeno(1,2,3-cd)pyrene	1	Yes	1,000	1	50,000	5E+7	2, p. BI-8
2-Methlynaphthalene	1	Yes	1,000	0.4000	50,000	2E+7	2, p. BI-9
Naphthalene	1	Yes	1,000	0.4000	50,000	2E+7	2, p. BI-9
Phenanthrene	1	Yes	0	0.4000	5,000	0	2, p. BI-9
Pyrene	1	Yes	100	1	50,000	5E+6	2, p. BI-10
1,2,3,4,6,7,8-HpCDD	1	No	10,000	1	50,000	5E+8	2, p. BI-6
1,2,3,4,6,7,8-HpCDF	1	No	10,000	1	50,000	5E+8	2, p. BI-7
1,2,3,4,7,8-HxCDD	1	No	10,000	1	50,000	5E+8	2, p. BI-7
1,2,3,6,7,8-HxCDD	1	No	10,000	1	5,000	5E+7	2, p. BI-7
1,2,3,7,8,9-HxCDD	1	No	10,000	1	50,000	5E+8	2, p. BI-7
Cadmium	1	No	10,000	1	5,000	5E+7	2, p. BI-2

TABLE 10: Toxicity/Persistence/Bioaccumulation							
Hazardous Substance	**Source No.**	**Observed Release? (Yes/No)**	**Toxicity Factor Value**	**Persistence Factor Value[1]**	**Bioaccu-mulation Value[2]**	**Toxicity/ Persistence/ Bioaccumu-lation Factor Value (Ref. 1, Table 4-16)**	**Reference**
Chromium	1	Yes	10,000	1	500	5E+6	2, p. BI-3
Copper	1	Yes	0	1	500	0	2, p. BI-3
Lead	1	No	10,000	1	5.0	50,000	2, p. BI-8
Manganese	1	Yes	10,000	1	50,000	5E+8	2, p. BI-8
Mercury	1	No	10,000	0.4000	50,000	2E+8	2, p. BI-8
Nickel	1	No	10,000	1	0.5	5,000	2, p. BI-9
Silver	1	No	100	1	50	5,000	2, p. BI-10
Zinc	1	No	10	1	5.0	50	2, p. BI-12

Notes:
[1] Persistence factor value for rivers
[2] Bioaccumulation factor value for fresh water
HpCDD Heptachlorodibenzodioxin
HpCDF Heptachlorodibenzofuran
HxCDD Hexachlorodibenzodioxin

Toxicity/Persistence/Bioaccumulation Factor Value: 5E+8
(Ref. 1, Section 4.1.3.2.1.4)

4.1.3.2.2 HAZARDOUS WASTE QUANTITY

TABLE 11: Hazardous Waste Quantity		
Source No.	**Source Type**	**Source Hazardous Waste Quantity**
1	Contaminated soil resulting from discrete operations (e.g., disposal practices) around the process area	Undetermined, but greater than zero

Source No. 1 contains multiple discrete areas of contaminated soil where facility operations and/or disposal occurred; however, the extent and continuity of contamination between discrete areas in Source No. 1 is not known (Refs. 8, pp. 15, 18, 20, 21, 30; 11, pp. 21, 38 through 42, 47 through 49; see Figure 3 of this HRS documentation record). Therefore, the area of Source No. 1 is undetermined, but greater than zero.

The Source HWQ value for Source No. 1 is undetermined but greater than zero. Because actual contamination at Level II concentrations is present in a fishery, and the hazardous constituent quantity is not adequately determined, the hazardous waste quantity receives a minimum factor value of 100 for the surface water migration pathway (Ref. 1, Section 2.4.2.2).

Sum of Source Hazardous Waste Quantity Values: >0
Hazardous Waste Quantity Factor Value: 100
(Ref. 1, Section 2.4.2.2)

4.1.3.2.3 CALCULATION OF HUMAN FOOD CHAIN THREAT WASTE CHARACTERISTICS FACTOR CATEGORY VALUE

The waste characteristics factor category was obtained by multiplying the toxicity/persistence and HWQ factor values, subject to a maximum product of 1×10^8. Then, this product was multiplied by the bioaccumulation potential factor value, subject to a maximum product of 1×10^{12}. Based on this product, a value was assigned in accordance with Reference 1, Table 2-7.

Toxicity/Persistence Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 100

Toxicity/Persistence Factor Value ×
Hazardous Waste Quantity Factor Value: 1×10^6

Toxicity/Persistence Factor Value ×
Hazardous Waste Quantity Factor Value × Bioaccumulation Factor Value (50,000): 5×10^{10}

Waste Characteristics Factor Category Value: 320
(Ref. 1, Table 2-7)

4.1.3.3 HUMAN FOOD CHAIN THREAT TARGETS

Level I Concentrations

No Level I concentrations have been documented.

Level II Concentrations

Level II concentrations have been documented in the Emory River. According to the U.S. Fish and Wildlife Service (USFWS), TDEC, and the Tennessee Wildlife Resources Agency (TWRA), the Emory River is fished adjacent to the CRC property and within the PPE. This area receives runoff from Source No. 1, and the fish are consumed (Refs. 33, p. 1; 42, pp. 1, 2; 57, p. 1; 63, p. 1). During the 2010 TDEC ESI, several fishermen were observed fishing on the Emory River adjacent to the facility (Refs. 33, pp. 1, 2, 3; 63, p. 1). Sediment samples CR03 0709SD, CR06 0709SD, and CR06 0709SDD were collected within the extent of the PPE which is within the fishery (Refs. 8, p. 7; 57, pp. 1, 2). The sampling locations are shown in Reference 8, page 30 (see Figure 3 of this HRS documentation record).

Most Distant Level II Sample

Investigation:	2009 Site Reassessment
Sample ID:	CR03 0709SD
Sample Medium:	Sediment
Hazardous Substances:	Benzo(a)anthracene, Benzo(k)fluoranthene, Carbazole, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, 2-Methylnaphthalene, Naphthalene, Phenanthrene, Pyrene, Chromium, Copper, and Manganese
Location:	Emory River, 0 feet from the PPE
References:	3; 8, pp. 30, 109, 290; see Tables 8 and 9 of this HRS documentation record

TABLE 12: Level II Fishery

Identity of Fishery	Extent of Level II Fishery (Relative to PPE)	References
Emory River	The extent of the Level II fishery is about 250 feet as measured from CR03 0709SD to CR06 0709SD; both samples were collected within the extent of the PPE	3; 8, pp. 30; 33, p. 1; 42, pp. i, 1; 57, pp. 1, 2; 63, p. 1 (see Figure 3 of this HRS documentation record)

4.1.3.3.1 Food Chain Individual

As noted in Section 4.1.2.1.1, an observed release of hazardous substances having a bioaccumulation factor value of 500 or greater is documented in perennial surface water body within a fishery (Emory River) (see Tables 9 and 11 and Figure 3 of this HRS documentation record). The Emory River (Watts Bar Reservoir) is used for recreational and subsistence fishing, and recreational activities such as boating and swimming (Refs. 21; 33, p .1; 42, pp. 1, 2; 48; 57, pp. 1, 2; 63, p. 1). According to the USFWS, TDEC, and TWRA, the Emory River is fished in the vicinity of the CRC property, which receives runoff from Source No. 1, and the fish are consumed (Refs. 33, p. 1; 42, pp. i, 1; 57, pp. 1, 2; 63, p. 1; see Figure 3 of this HRS documentation record). During the 2009 and 2010 TDEC sampling events, several fishermen were observed fishing on the Emory River between the observed release samples (Refs. 33, pp. 1, 2; 57, pp. 1, 2). The types of fish caught and consumed from the Emory River include catfish, crappie (black, blacknose, and white), and bass (largemouth, rock, smallmouth, striped, spotted, white, and yellow), bluegill, redear, and redbreast (Refs. 42, pp. 1, 2, 3; 57, p. 1). A fish consumption advisory for mercury is currently in effect for the Emory River; however, the limits of this advisory (upstream of river

mile 12.4) are located upstream from the CRC property (at approximately river mile 11.5) (Refs. 19; 37, p. 2).

Sample ID: CR03 0709SD
Level I/Level II/Potential: Level II
Hazardous Substances: Benzo(a)anthracene, Benzo(k)fluoranthene, Carbazole, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, 2-Methylnaphthalene, Naphthalene, Phenanthrene, Pyrene, Chromium, Copper, Manganese
Bioaccumulation Potential: 50,000

Sample ID: CR06 0709SD
Level I/Level II/Potential: Level II
Hazardous Substances: Benzo(a)anthracene, Benzo(k)fluoranthene, Carbazole, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, 2-Methylnaphthalene, Naphthalene, Phenanthrene, Pyrene, Manganese
Bioaccumulation Potential: 50,000

Sample ID: CR06 0709SDD
Level I/Level II/Potential: Level II
Hazardous Substances: Benzo(a)anthracene, Benzo(k)fluoranthene, Carbazole, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, 2-Methylnaphthalene, Naphthalene, Phenanthrene, Pyrene, Manganese
Bioaccumulation Potential: 50,000

Food Chain Individual Factor Value: 45
(Ref. 1, Section 4.1.3.3.1)

4.1.3.3.2 Population

4.1.3.3.2.1 Level I Concentrations

No Level I concentrations have been documented.

4.1.3.3.2.2 Level II Concentrations

The Emory River is evaluated as a Level II fishery. According to the USFWS, TDEC, and TWRA, the Emory River is fished adjacent to the CRC property and within the PPE. This area receives runoff from Source No. 1, and the fish are consumed (Refs. 33, p. 3; 42, pp. i, 1; 57, pp. 1, 2; 63, p. 1; see Figure 3 of this HRS documentation record). Information is not available on the annual production of fish caught in the Emory River within the TDL. Therefore, the annual production for the water body is undetermined but greater than zero because the Emory River is a fishery (Refs. 33, p. 1; 42, pp. i, 1; 63, p. 1).

Identity of Fishery	Annual Production (pounds)	Population Value (P_i) (Ref. 1, Table 4-18)	References
Emory River	>0	0.03	3; 22, pp. 1, 3; 33, pp. 1, 2, 3; 57, pp. 1, 2; 63 p. 1

Level II Concentrations Factor Value: 0.03
(Ref. 1, Section 4.1.3.3.2.2)

4.1.4.2 ENVIRONMENTAL THREAT WASTE CHARACTERISTICS

No wetlands are located in the immediate vicinity of the CRC property (Ref. 43, p. 1). No sensitive environments or sensitive species are located on the Emory River within the 15-mile downstream TDL (Refs. 38, p. 1; 63, p. 1). The environmental threat was not scored because it is not expected to significantly contribute to the overall site score.